

DISTRICT TUBERCULOSIS PROGRAMME

**MANUAL FOR
X-RAY TECHNICIAN**

THIRD EDITION



Government of India
National Tuberculosis Institute
Directorate General of Health Services
Ministry of Health & Family Welfare
8, Bellary Road, Bangalore 560 003

1994

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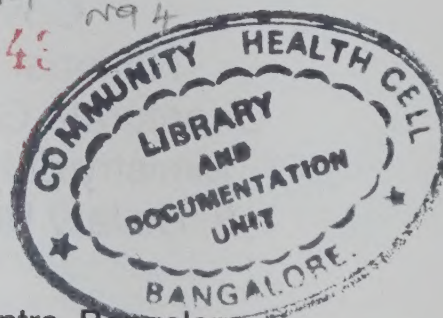
First published : 1962
Second Edition : 1978
Third Edition : 1994

Published by

National Tuberculosis Institute
8, Bellary Road, Bangalore 560 003, INDIA

DIS-319

05348



Printed at INSDOC Regional Centre, Bangalore
No. of copies printed : 500

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Manual for X-ray Technician

1. Purpose

This manual contains work instructions to enable X-ray Technician (XT) to take chest photofluorograms of patients attending the District Tuberculosis Centre (DTC), maintain X-ray and Dark Room Equipment properly, ensure timely and adequate supplies of X-ray films and chemicals and function as Registration Clerk when no separate person is provided.

X-ray Technician is responsible to District Tuberculosis Officer (DTO) performs his duties under DTO's guidance.

2. Duties and Responsibilities

X-ray Technician will carry out his duties with the help of the assistance provided. Following are the main duties:

- i) To receive X-ray and Dark Room equipment, accessories and supplies meant for X-ray Section of DTC, prepare an inventory upto-date;
- ii) After installation, check proper functioning of X-ray unit, maintain the unit and the accessories properly, ensure prompt and satisfactory action for repairs and recheck proper functioning after each repair;
- iii) Timely indenting of X-ray films, chemicals and other requirements;
- iv) Check fog level of freshly received X-ray film rolls and condition of the chemicals;
- v) Take chest photofluorograms of patients attending X-ray section and process the exposed X-ray films;
- vi) Examine processed X-ray films for technical faults and ensure that such faults do not recur;
- vii) Put up before DTO the processed X-ray films for "reading" and old films for comparison, along with necessary records;
- viii) File processed films in a systematic manner and store unexposed film rolls in a refrigerator;
- ix) Register outpatients in DTC on Casefinding Registration Form (CFRF), where no separate Registration Clerk is provided;
- x) To train and guide the X-ray Technicians of peripheral health institutions equipped with Odelca camera (XC) according to the manual as required by DTO;
- xi) Perform any other duty allotted by DTO in DTP.

3. X-ray Equipment and Accessories

NOTE: There are several types of X-ray units working in the DTCs. 190 of these are Siemens Seriophos-5 X-ray units supplied by the UNICEF and installed between the years 1962 and 1978. This manual was originally written for use in DTCs equipped with

Seriophos-5 X-ray units. Therefore the equipment referred to in the main text of the manual is Siemens Seriophos-5.

For District Tuberculosis Centres not equipped with Siemens Seriophos-5, but with other types of equipment which includes:

- a) Siemens Monophos – 3,
- b) Wattson Rontgen, and
- c) Escorts Diaflex.

supplied before 1962 by the Directorate General of Health Services (DGHS) and Siemens Ergophos 4m. supplied after 1979 under SIDA Aid.

The X-ray Unit and Dark room accessories for use in DTCs are now provided through the DGHS. Components of this unit are detailed in the Appendix II and would be relevant to most DTCs.

3.1 Receiving X-ray Unit

Follow the undermentioned steps:

- i) Check all Roadways/Railways/Government Medical Store vouchers or receipts to locate discrepancies, if any, in the matter of packages that ought to have been received and damages to the packages during transit. If short supplied or damaged, bring the matter immediately to the attention of DTO for suitable administrative action (3.7),
- ii) Before opening packages containing equipment and accessories, make sure that,
 - a) X-ray room is ready with water supply & 3-phase power line terminating in it,
 - b) Some X-ray films and chemicals are readily available for checking proper functioning of the unit and,
 - c) Dark room is ready or (a day light developing box is available).
- iii) Request DTO to contact firm's X-ray Engineer to instal the unit. All packages including those damaged in transit should be opened only in the presence of firm's Engineer,
- iv) Identify all parts as they are unpacked, against the supply list (if available) with the help of Firm's Engineer. Prepare a complete and systematic inventory of all the parts before installation begins,
- v) Enter inventory in X-ray Log Book (9.1.3) Shortages, damages and results of initial and subsequent tests on the X-ray unit should be noted in a separate portion of Log Book, after discussion with DTO in the presence of X-ray Engineer,
- vi) Where a unit is already installed and no inventory is available, prepare one and enter it in Log Book. If inventory is available, identify each part against the inventory in the Log Book and obtain special instructions regarding maintenance of X-ray unit from the outgoing XT.

3.2 Installation of X-ray Unit

3.2.1 Plan of Installation

X-ray unit may be installed according to Fig.1 where X-ray room is of size 4.5×5.5 metres ($16' \times 20'$) or bigger.

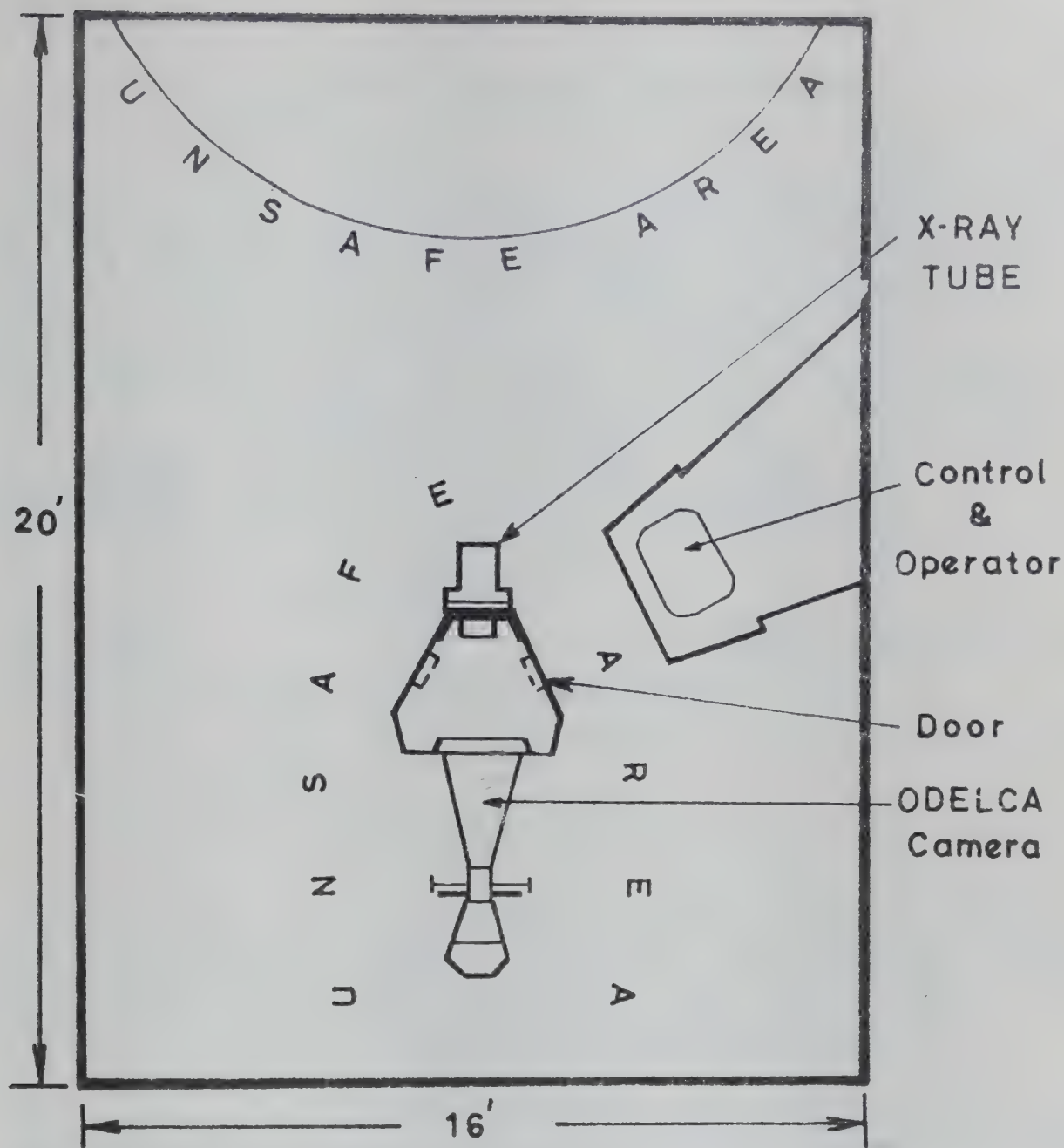


FIG . 1

3.2.1.1 During Installation

X-ray Technician should be present throughout the installation and follow each step carefully and obtain necessary clarification from X-ray Engineer, when he is in doubt. He should also get instructions from him on proper maintenance of equipment.

3.2.1.2 Protection from Radiation

Unnecessary exposure to X-rays is dangerous to health. XT and others in the X-ray room have to take precautions to avoid unnecessary radiation. The plan of installation in 3.2.1 indicate the safe and dangerous zones. For precautions against radiation hazards see Appendix III.

3.3 Checking Installed X-ray Unit for Proper Functioning

Any X-ray unit, either freshly installed or already functioning should be systematically checked for proper operation at the time of taking over according to 3.3.1 (for code words see Figs. 2 and 3).

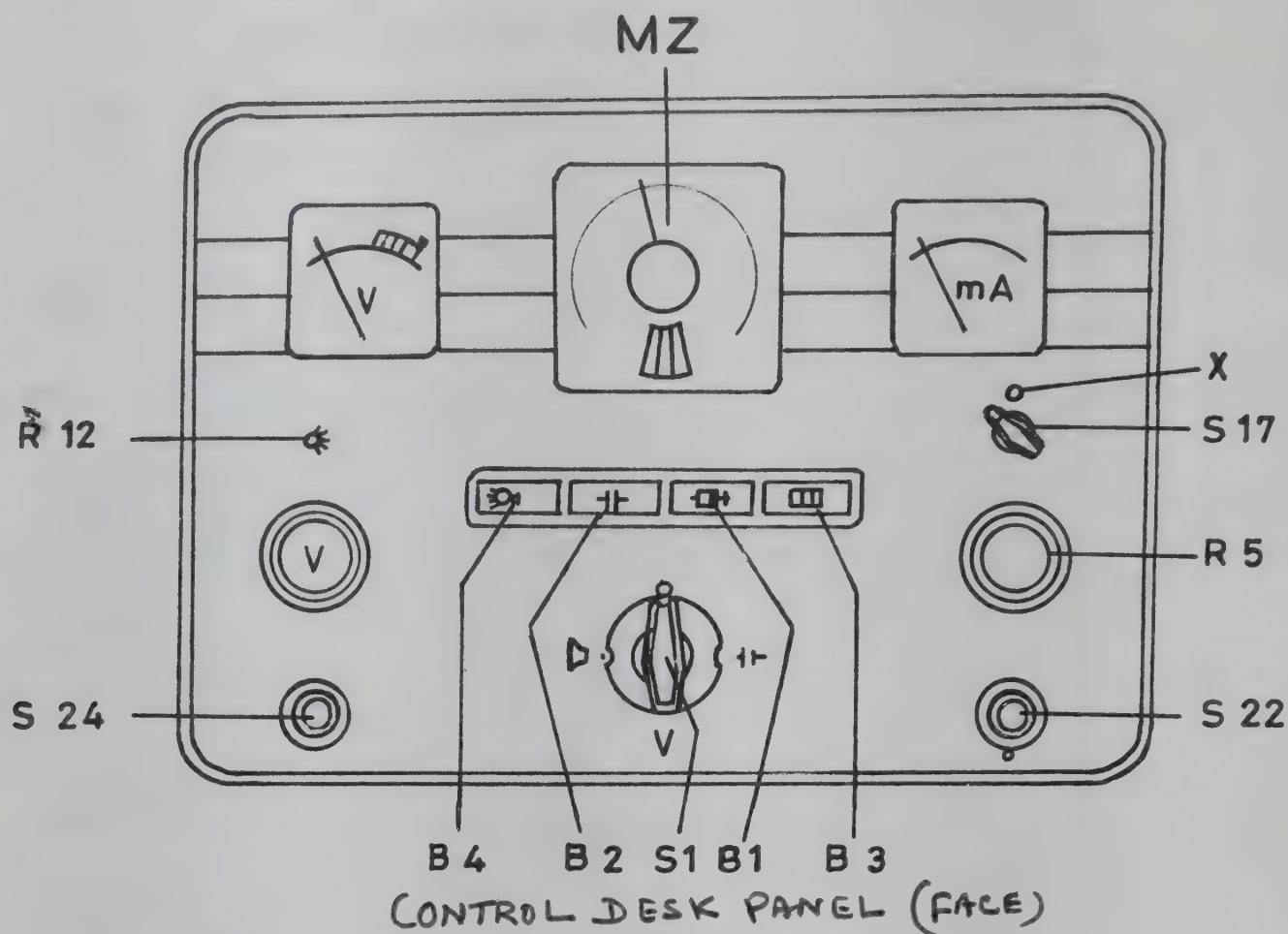


FIG. 2

CAUTION

An electric shock, even of a minor nature, if experienced on touching any part of the installed X-ray unit indicates improper earth connection. XT informs DTO to get the earth connection properly checked up by the local Electricity Board. The X-ray Engineer should not be called for this purpose.

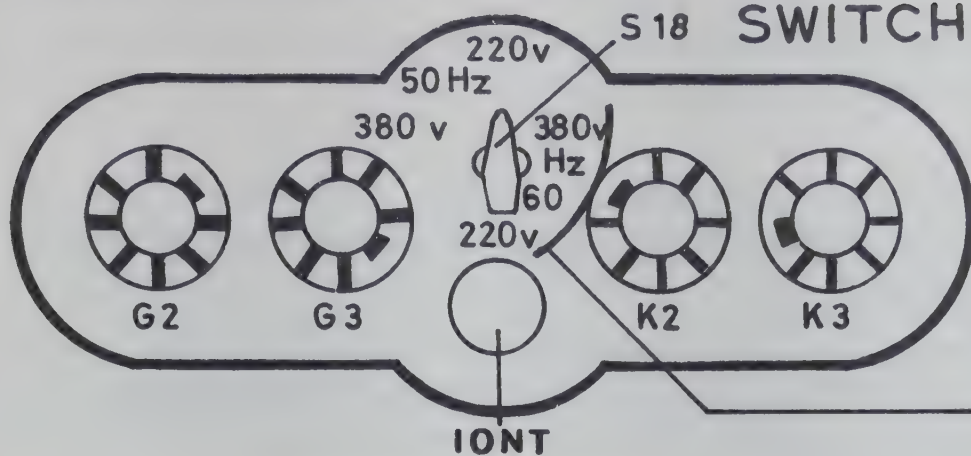
3.3.1 Checking Operation without Safety Device Control Desk Panel (FACE)

- i) Check that all line fuses are intact. The unit is connected to correct power supply voltage. The zero setting of the voltmeter with control "off" is correct (if not, correct it). The line voltage compensator control knob "V" is at minimum position (maximum anticlockwise rotation).
- ii) Now, switch on the control desk and see if line voltage compensator is working properly so that voltage can be adjusted to delta mark "V" on voltmeter. If voltmeter cannot be adjusted by line voltage compensator, check position on switch S18 (back of the control desk) and ensure that it is indicating correct power supply voltage. That is 380 volts if connected to 400 volts power supply and 220 volts if connected to 230 volts power supply. If the voltmeter needle remains beyond "V" mark even after adjusting line compensator "V" to minimum position it indicates power supply voltage is high. Get it checked by the local Electricity Board and if voltage is between 410 and 440. The firm's X-ray Engineer must be asked to modify the unit in such a way as to work on power supply upto 450 volts. If voltage is higher than 450 volts, the local electricity office should be requested to reduce voltage.

CAUTION

Never turn switch S.18 to either 380 volts, 60 HZ or 220 volts, 60 HZ. It should always be in position of either 380 volts, 50 HZ or 220 volts, 50 HZ.

LINE VOLTAGE SELECTOR



CONTROL DESK PANEL (BACK)

FIG. 3

The Voltage Test

- iii) Having adjusted voltmeter, turn Selector Switch S.1 to position "V" and listen for blower fan sound from tube-head.
- iv) Now, set Timer MZ to position "V" and see that the pointer in voltmeter is still at delta mark. Press exposure switch S.22 and observe pointer after it becomes momentarily steady following the initial deflection (duration of steady state is less than one second). Note the colour band on which the voltmeter pointer rested. The colour seen in window marked "X" should be the same as above (colour band). Listen also for the sound made by the rotating anode in the tube head.
- v) Now, turn switch S.1 to "D" camera position, set Timer MZ to 0.10 second, ensure that voltmeter pointer is on the delta mark (if not, correct through line-voltage compensator "V") and press switches S.24 and S.22, simultaneously while observing mA meter.

After half a second the sound of the radiographic contactor should be heard and mA meter should deflect. Listen again to the the sound made by the rotating anode and note that it continues for atleast one minute after switch S.22 is released. If necessary, switch "off" control desk at this stage to distinguish between the sounds made by rotating anode and blower fan respectively.

The above tests if successful, indicate that:

- a) X-ray unit is connected to correct power supply,
- b) Anode inside tube head is rotating normally, and
- c) X-ray unit is producing X-rays.

X-ray Tube Current Test

- vi) Now adjust knob R.5 to 70 kV position, set Timer to 1.0 second, observe mAS in the window of Timer (when an exposure is of 1.0 second, the mAS value is the same as mA) and below the colour band seen in the window - for example, brown colour means the value of mA is same as white 60mA. Make an exposure by pressing switches S.24 and S.22 together. mA meter needle should kick and stop momentarily over the second thin line after the thick centre line, when conditions are as per the example given above.

(thin lines in the mA meter correspond to 5 mA and thick lines to 20 mA intervals). But for other situations as indicated by different colours in window X, the corresponding values of mA must be indicated by mA meter red or blue as 80 mA, white or brown as 60 mA and orange or rose as 50 mA.

CAUTION It is important that observed mA should not vary more than $\pm 4\%$ i.e. 77 to 83 mA for red and blue lines 58 to 62 mA for white and brown lines and 48 to 52 mA for rose and orange lines.


- vii) Lastly, ask a heavy weight person to stand on the patient's platform and operate the lift. Observe smooth running of the motor i.e. without producing a grinding noise or causing heavy voltage drop in the control. Before the lift motor is operated voltmeter should indicate correct value ("V" mark).

The following should be reported to DTO, if the X-ray Engineer is not available for immediate action (Refer RCXU Siemens Serophos 5 unit - ~~page 39~~)

Blower fan defect (3b)
Rotating anode defect (5a)
Wrong adjustment of tube current (7)
Lift motor defects (15)

3.3.2 Checking Operation of Safety Device of Odelca Camera

It is important that the following tests **should be made without pressing switch S.24 (unless stated otherwise):**

- i) Switch on the control observe glow in pilot lamps B₁ and B₃, turn switch S.1 and Timer to position "V", press switch S.22 and observe glow in Pilot lamp B₄ the glow should last for 0.5 seconds and go off just as radiographic contractor sound is heard. If this test is alright, the card illumination system is working; the level of illumination however may need adjustment (3.3.3).
- ii) Now turn switch S.1 to camera position " , press switch S.22 and confirm that exposure does not take place, insert a roll film cassette (RFC-2) or RFC-3 depending on the type of the camera taking care to see that intermediate piece is in position, advance X-ray film by one frame and bring handle back to original position. Pilot lamp B₁ should go "off". Now press switch S.22 again to make an exposure and confirm that exposure does not take place. Pull out card holder, push it back without putting a token card; Pilot lamp B₃ should continue to glow, and no exposure should be possible. Pull out card holder once again, insert a token card, push back the card tray; no exposure should take place by pressing switch S.22 and pilot lamp B₃ should continue to glow.

Now, pull out dark slide, of the Roll Film Cassette; Pilot lamp B₃ should also go "off" and exposure should be possible when switch S.22 alone is pressed. If no exposure is possible, check doors of the radiation protection booth, since an exposure should be possible when the doors are properly closed.

CAUTION To avoid a false conclusion, do not press switch S.24 at all. Advance X-ray film partially by stopping short of the end position (handle should not fall back to original position), pull out card holder and push it back after inserting in a token card; pilot lamp B₃ should not go "off" and exposure should not be made when switch S.22 is pressed.

NOTE: When RFC-3 Cassettes are used (in 70-SL 1 Cameras), exposure will be blocked when cassette is without film.

The successful completion of these tests means that Safety Device components are working satisfactorily. Any shortcomings in the working of the Safety Device should be reported to DTO for necessary action.

3.3.3 Adjustment for Film Density and Card Illumination

- i) The following steps are required when card illumination (or film density) need adjustment. Adjust the card illumination control screw to minimum (accessible through the hole on right-hand side of the control desk bottom end) put graduation marks with pencil on the control cover of this screw.
- ii) Take token cards numbered 1-10 for the following test and record results in the form of a table in separate portion of log Book (9.1.3) as shown below. For mAS values for different types of X- ray films and developers, see Appendix IV and then adjust Timer settings accordingly in column 3 of Table I. The values given below are when Agfa Gevaert Scopix G-I S, RP2 X-ray film Indu X-ray Roll Films & Agfa Gevaert T.209 developer/Indu developers are used with developing time 6 minutes at 20°C.

Table - I
(Applicable for Seriophos - 5 and Ergophos-4M machines
with 20 mm Aluminium phantom as an object)

Token No.	'R.5' on kV	Timer settings	mAS value (If available)	Position of card illumination control	Remarks
1	2	3	4	5	6
001	70	for 16 mAS		0	control strip
002	70	– do –		1	
003	70	– do –		2	
004	70	for 20 mAS		3	
005	70	– do –		4	
006	70	– do –		5	
007	70	for 24 mAS		6	
008	70	– do –		7	
009	70	– do –		8	
010	70	for 30 mAS		9	

- iii) Now, advance the film, pull out dark slide, insert token card 001 in card tray, set control panel as given in the first line of the above table and expose. Continue the test as per the table till the last card (010) has been exposed. Develop the film, dry it, cut out the first three "frames" and compare film density of the exposed area in this strip with the density of the exposed areas in the remaining frames, one by one. Pick up the frame that has density nearest to the control strip (cut out portion of the film). Also underline the token number that is the clearest and note the position of the card illumination control screw for that token number. Set card illumination screws at the selected values.
- iv) It is necessary to get DTO's approval of the film density and card illumination adjustments indicated by the above test. Take photofluorograms of 8 to 10 persons with kV values varying from 70 to 110 (in steps of 10 kV each) and timer set at 20 mAS (taking care to adjust the position of patients correctly). Record token card numbers

against set kV values as well as thickness of patients (when mAS meter is available, also record respective mAS values). Process X-ray film according to Time-Temperature graph and show this film to DTO. If he is satisfied, no further adjustment need be made. However, if he prefers film density higher or lower than the film shown then adjust R.12* setting to get the required density (one step or a part thereof anti-clockwise if reduction and clockwise if increase in density is desired), - the degree of adjustment is roughly indicated by the exposure table above. The mAS values should be at least 50% more or 25% less than the nearest good frame in the X-ray film strip. If DTO prefers higher contrast, exposure should be made 10 kV lower than the best available frame and for reduced contrast 10 kV higher. After making the readjustments, take another series of pictures to get DTO's final approval.

Similar tests have to be done after all major repairs on the X-ray unit, especially the Iontomat. It is important to note down each series of tests and the resulting values in the Log Book, with date on which each test was carried out.

3.4 Use of Different Kinds of Cassettes

Two types of Odelca cameras and four corresponding kinds of cassettes are supplied to DTCs (Table II). A DTC will have only one type of camera and the corresponding kinds of cassettes. When cassettes are borrowed from another DTC, to tide over emergencies, it has to be ensured that correct type of cassettes are obtained.

Table II

Camera Type	Roll Film Cassette to be used	Single Film Cassette to be used	Desiccator	Easy identification particulars
1	2	3	4	5
70-VII-U 70-SL-I	RFC-2 RFC-3	SFC-3U SFC-4	Desiccator DSC-4	Film gate is blank Film gate is covered by glass plate

The use of a single film or roll film cassette depends on the average number of X-rays taken per day in a DTC. There are operational advantages and disadvantages connected with the use of each kind of cassette. The appropriate instructions for their use are given in Table III.

3.5. Expendable Supplies

The quantity of yearly expendables for a DTC depends entirely on the work load, if there is no wastage. To begin with, the following quantities may be procured as initial stock, and then replenishments are ordered as per the actual consumption every year, according to the established supply procedures in each State. For expendable items refer Table IV.

R.12* applicable to Seriophos-5 machine where Iontomat is working and not applicable for Ergophos-4M machine; refer page numbers ~~33 and~~ 44.

3.5.1 Indenting Procedure for X-ray Roll Films

The existing procedure of direct supply of miniature X-ray film rolls twice a year from the Directorate General of Health Services, New Delhi to the DTCs will continue.

Table III

Sl.No.	Particulars	More than 12 X-rays daily	Less than 12 X-rays daily
1	2	3	4
1	Cassette and film to be used	RFC Cassette with Roll film	SFC Cassette with single film
2	Loading of film	As per 4.1.2	As per 4.4
3	Identification	As per 4.1.3	As per 4.1.3 & As per 4.4.4
4	Unloading of film	As per 4.1.4	As per 4.4
5	Minimum frequency of film processing	Atleast on alternate days	As per 4.4 daily
6	Processing, washing and drying of films	As per 4.6	As per 4.7
7	Storage of fresh films	As per 5.3.1	As per 5.3.1
8	Filing of processed films	As per 5.3.2	As per 5.3.2.3
9	Registration & disposal of outpatients	As per 8.0	As per 8.0
10	Log book entries	As per 9.1.3(iv) cols. 5,8, & 9	As per 9.1.3(iv) cols. 5,8, & 9
11	Procurement of films	120 or more Rolls yearly as required	Not more than 80 packets of 50 films yearly
12	Developer and fixer powder (2 gallon packing)	6-12 packets yearly	6 packets

Table IV

Sl.No.	Item	Quantity
1	Silica gel	500 gms (one tin)
2	Absorbent cotton (not required for single films)	5 Rolls
3	Detergent liquid (Tipol)	3 Bottles (1.5 litres)
4	Cleaning powder (Vim)	12 Tins
5	Adhesive and cellophane tapes	2 Rolls each
6	Towels	5 Nos
7	Soap cakes	24 Nos.
8	Polythene bags (15 cm wide) stainless steel container (16.5 cm diameter)	200 (only when stainless steel vessel is not available)
9	Mud pots (Large) 30 litres	2 (when required)
10	X-ray films, Developer, fixer	As per Table III
11	Log Book (300 page foolscap, hard cover)	one
12	Token cards	300
13	Exercise note books (100 pages, for registers of patients under treatment and patients under observation)	2

The miniature X-ray film rolls would be supplied on receipt of the prescribed proforma in Jan/July each year.

The prescribed proforma in receipt of miniature X-ray film rolls is to be sent to the Directorate General of Health Services, New Delhi by 15th Jan/15th July each year.

If there is delay, in submitting the proforma (duly completed in all respect) within 15 days of each of the prescribed 6 monthly period, supply may not be possible as per the requirements. For proforma refer Introduction to DTP page 21, ~~Table IV~~, Appendix IV B.

It is advisable to have a small stock of spares such as fuses, pilot lamp bulbs, spiral spools, thermometer and soliscope viewer bulbs so that minor repairs and replacements can be undertaken.

3.5.2 Storage of Expendables

X-ray films are stored in the refrigerator (1.0 cubic feet space per 100 rolls) to avoid deterioration. It is advisable to place them in the last but one compartment because they need not be stored near the freezing chamber and in the lowest compartment they might get soaked in the event of power failure. When fresh stock of films are received, the films with the longest expiry dates are kept behind the ones with earlier expiry dates.

Chemicals are stored in a cool dry place in a cupboard.

Developer and fixer solutions, prepared in two gallon quantity, are stored in well stoppered dark plastic bottles.

3.6 Furniture and Fixtures

The list of furnitures, fixtures and accessories for efficient working of X-ray Section is given in the Appendix I & II. The items have to be procured by the State Government at the start of the DTC and may need replacement. XT must find out what items are available and request DTO to arrange for the rest.

3.7 Administrative Actions

Packages received in damaged condition or in short supply are intimated to DTO by XT for sending an immediate reference to Medical Stores Depot and the Roadways/Railways concerned (3.1).

X-ray Technician prepares separate lists of shortages and damages of parts received and submits them to DTO who in turn informs the DGHS and the Medical Stores Depot concerned (3.1).

X-ray Technician also requests the firm's X-ray Engineer to give him a signed report in triplicate of the exact part(s) required to instal or repair and get the X-ray unit working. The DTO is expected to forward one copy each of the report, to DGHS and National Tuberculosis Institute (NTI) for arranging the supply of the spare part(s) if available from NTI store. If not guidance will be given by NTI for the procurement of the same from other agencies.

4.0 Preparation of X-ray Unit for Use

4.1.1 Testing of X-ray Unit (Serophos 5)

- i) Make sure that Switch S.18 (See Fig 3 Page 5) is in 380 volts, 50 Hz position
- ii) See that all plugs in the X-ray control, tubehead, camera and patient lift are properly fixed
- iii) Keep line compensator "V" in minimum fully anti-clocwise position (Fig.2)
- iv) Put "on" main switches on the wall and on the control desk
- v) See that voltmeter on the control desk is showing voltage of correct value at delta mark (3.3.1, ii)
- vi) Check working of blower fan (3.3.1, iii) and pilot lamps B₁ and B₃ (3.3.2, i)
- vii) Set switch S.1 and Timer to position "V"
- viii) Press switch S.22 to perform the "Voltage Test" (3.3.2.i)

- ix) Observe window 'x' (S.17) and ensure that colour band is the same as indicated by the "voltage test" (3.3.1,iii) for Testing of Ergophos 4M unit refer page No. 42..

4.1.2 Roll Film Cassette (RFC)

The main parts of RFCs 2 and 3 along with the procedures for their use are given in the Appendix V. When two RFCs are supplied they are to be used alternatively every month. Make sure that the adaptor plug (intermediate piece) is in position when changing the cassette. While one RFC becomes defective, get it repaired forthwith as the second one may also fail at any time.

Following are the steps for loading and unloading of RFC:

- i) Removal of Magazine.
- ii) Loading of X-ray film in magazine should always be done, in total darkness. Before switching "off" the light, make sure that an empty spool, scissors, rubber band and a X-ray film roll taken atleast 12 hours earlier from the refrigerator are available at hand.
- iii) Inserting of loaded magazine in RFC.

CAUTION Remember that RFC is not light proof. Therefore, RFC should be taken from and to the darkroom in a black bag.

- iv) Before inserting RFC into camera make sure that the intermediate piece is in position.
- v) Pull out dark slide of RFC and advance film by one frame. Now B₁ should go off.
- vi) Put a token card in card tray and check whether pilot lamp B₃ goes off indicating proper functioning of Safety Device (if pilot lamp B₃ is not going "off", check dark slide by rocking it lightly to make its contact operate).

Now RFC is ready for exposure. But before making exposures make sure that the reset knob "T" has been pressed to bring the number to "0" (Fig.1a Appendix V).

4.1.3 Identifying the Films

- i) Every day before starting exposing the film, stick with adhesive tape the date of exposure Roll No.using lead numbers on the left hand top corner of the camerahood (eg:15/8/92).
- ii) Make sure that card illumination device is working during the voltage test (B₄ pilot lamp glows just before exposure). If not working the marking of each exposure will have to be done with lead numbers on right hand top corner of the camerahood. Use adhesive tape for sticking.

CAUTION With three metre film roll only 45 exposures should be made. The film counting device of the RFC should indicate the number of exposures already made but under no circumstance should RFC be operated to the extent that window of the counting device indicates parallel lines as shown below. If this happens, then RFC is over-wound and it will cause damage. Refer Figs 4 and 5. **on page 12.**

4.1.4 Removal of Magazine and Unloading of Exposed Film

- i) After the last exposure has been made, make the identifying exposure. Advance film by two or three frames and remove RFC from camera.

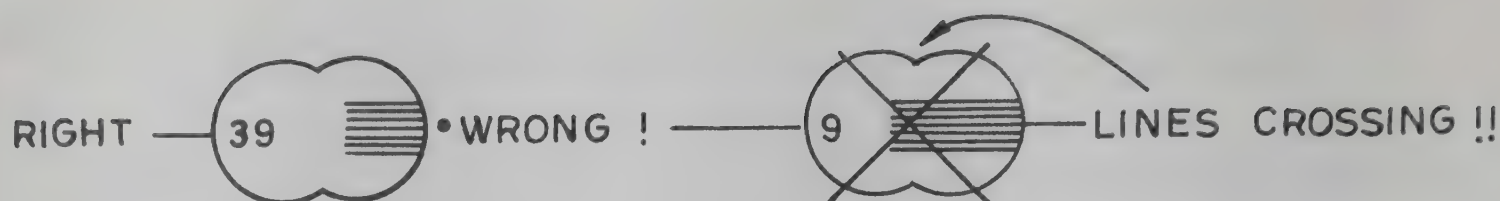


FIG. 4

FIG. 5

- ii) Put RFC into a black cloth bag, insert desiccator or another cassette into the cassette-port of camera (port should never be left open) and take RFC into dark room. The unloading of the magazine from RFC can be carried out as under 4.1.2.

4.2 Receiving and Positioning of Patients

- i) When XT is registering patients, after registration, he positions and takes X-ray of each patient before registering the next. This ensures that the order of X-rays taken is the same as that of registration. In the case of large attendance, patients "Q" up and wait for their turn at the registration desk. Under this condition the Exposure Register is not needed (9.1.2). If for any reason more than one exposure are made for the same patient, the fact should be recorded in the Case-finding Registration Form (CFRF) so that identification of exposures is definite. Where a Registration Clerk does the registration, XT receives patients one by one, enters the particulars in the Exposure Register, positions and takes the X-ray before attending to the next patient. XT informs the Registration Clerk when the film roll is changed.
- ii) Ensure that patients remove their shirts, silk clothes, ornaments, coins and other X-ray opaque materials from chest area. For long hair, use a hair cap to keep hair away from lung field. Provide dressing gowns to ladies, when necessary.
- iii) Position each patient carefully with chin on chin-rest, hands on hips and shoulders and elbows touching the camerahood. After positioning, lower the patient lift about an inch so that neck gets well stretched.

4.3 Making Exposures

Choose the high kVp technique, if DTO does not object to low contrast films.

4.3.1 Settings for Operation with Timer

- i) Set timer to 20 mAS, select kVp according to thickness of patient:

Child below 12 years : 70 kVp

Adult with chest thickness:

a) Upto 20 cms. : 80 kVp

b) Between 20 & 24 cms. : 90 kVp

c) Beyond 24 cms. : 100 kVp

- ii) Adjust lateral shutters of collimator to cover those parts of camerahood left uncovered by body and the horizontal shutter to slightly above the iliac crest (when collimator light

is not working, use colour code lines on camerahood and the corresponding stops on collimator shutter control)

- iii) Ask patient to take a deep breath and hold it. To make sure that he/she understands this instruction, a trial should be made while XT observes the patient and not the X-ray Control. The exposure should be made only after the patient has understood this instruction
- iv) Make sure that the patient has not moved from his/her position (4.2, iii), voltmeter needle is still on "V" and patient is holding the breath
- v) Make the exposure
- vi) Ask patient to relax, and come down from the patient lift and remove card from card tray (stack separately for re-use)
- vii) Call the next patient, identify as per 4.2, insert next token card in card tray, advance film and proceed as for the first patient
- viii) When the last patient has been X-rayed or when a sufficient number of exposures have been made — for the length of X-ray film loaded in the RFC — make the final identification exposure (4.1.3, i). Remove film from RFC (4.1.4) and process the film (4.6).

4.3.2 Settings for Operation with Manual Control of Exposure

When Iontomat is not functioning properly, X-ray can be taken with manual exposure control but satisfactory results are possible only when mA is correctly adjusted according to colour code (3.3.1) and kVp is adjusted according to patient's thickness (4.3.1,i). The timer should be adjusted for 10 mAS in every case when using Agfa Gevaert Film (Scopix G.I.S) Indu film and Agfa Gevaert T 209 developer and Indu developer. In case of other brands of films and chemicals, refer to Appendix IV and correct the technique accordingly.

4.3.3 Settings for Operation without Safety Device

When Safety Device is not functioning, exposures are made by pressing switches S.22 and S.24 simultaneously. As the exposure will not be blocked when film is not advanced or token card is not changed. XT should take extra care to see that these operations are done systematically. Every time a patient is positioned, the token card should be inserted in card tray and the film is advanced. In case of doubt, re-check the token card in the card tray and advance the film once more, as it is better to miss one frame of the film than to spoil a previous exposure by a double exposure.

4.3.4 Procedure when Card Illumination is not Working

When card illumination device is not working as indicated by the pilot lamp B₄ frames are marked correctly with the help of CFRF/Exposure register. After the film has been processed XT correctly identifies and numbers the frames according to CFRF/Exposure list, with Indian Ink or film marking pencil.

4.4 Single Film Cassette (SFC)

The main components of SFC along with the procedure for its use are given in the Appendix V. Following are the steps for loading and unloading of SFC:

- i) Insertion and Removal of SFC

When SFC is removed, insert desiccator or another Cassette into Cassette-port.

ii) Loading and un-loading X-ray film.

Loading and unloading of SFC should be done in total darkness. The exposed films removed from SFC are kept in a light proof box safely in the dark room till they are developed. (For loading procedures see Appendix V).

4.4.1 *Marking Exposure*

Mark the camerahood as in 4.1.3.

The technique is the same as under 4.2 and 4.3 except that switch S.24 has to be pressed in addition to S.22 Particular care must be taken to see that token cards are placed correctly and only one exposure is made after the insertion of the SFC and that dark slide is opened before making the exposure.

When card illumination device is not working (4.3.4), the single films are identified with lead numbers stuck on to the camerahood (as is done for full size radiographs), on the left hand top corner below the frame. The date and roll numbers are written after development as above.

4.5 **Preparing Dark Room for Processing of Films**

Processing, washing and drying of exposed X-ray films is done in the dark room. Since processing is to be done in total darkness and not by inspection method, the quality and temperature of developer and time of development have to be controlled very accurately. Dividing developer and fixer powders for preparing solutions in instalments is a wrong procedure. Full quantities of solutions (as indicated on the packages) should be prepared atleast 24 hours before use, to get proper homogeneity. The preparation should be according to the directions given by the manufacturer and the solutions should be stored in dark plastic bottles after stirring them well to see that all the chemicals have dissolved. When filled in more than one bottle, the first bottle should be filled upto stopper and those bottles should be used only after the solutions of the partially filled bottles have been used up.

Following are the steps to be taken before starting processing:

- i) Fill developer tank to correct level with fresh solution (about 2 litres). If tank is already containing good solution (used on the previous day), check level and top up with developer solution. One tank full is good for developing 6 film rolls of 3 metre but if solution remains in tank for 12 days, it should be discarded even if 6 rolls have not been developed.

NOTE: When 3 gallons (13.5 litres) capacity tanks are supplied, the developer should be changed according to large size film equivalent to roll films i.e. 40 rolls can be processed or should be used within 60 days from the date of preparation should be discarded.

- ii) Change water in rinse-tank with fresh water for every roll processed.
- iii) Check the level of fixer tank and top up
- iv) Check temperature of developer, fixer and rinse water, If temperature of developer is above 20°C take (from refrigerator) 16 ice cubes in a suitable stainless steel vessel

and place it on top of developer tank so that bottom of the vessel touches the solution. If a stainless steel vessel is not available, take a plastic cover of approximate size 15×15 cms, insert the 16 ice cubes in it, tie the end tightly and allow the bag to float on developer solution till temperature comes to 20°C . If temperature cannot be corrected for want of ice, see Time Temperature graph for obtaining the correct time of development.

- v) If temperature of fixer solution is above 20°C , put ice cubes in plastic cover, different from the one used for developer, and float it in fixer solution. (The variation in temperature between developer and fixer should not exceed beyond $\pm 2^{\circ}\text{C}$ to avoid reticulation effect).

CAUTION

When temperature of solutions is below 20°C . get stainless clad immersion heaters for raising temperature of the solution — (200 watts heater will be sufficient).

- vi) Top up solutions if spilling takes place during temperature control.

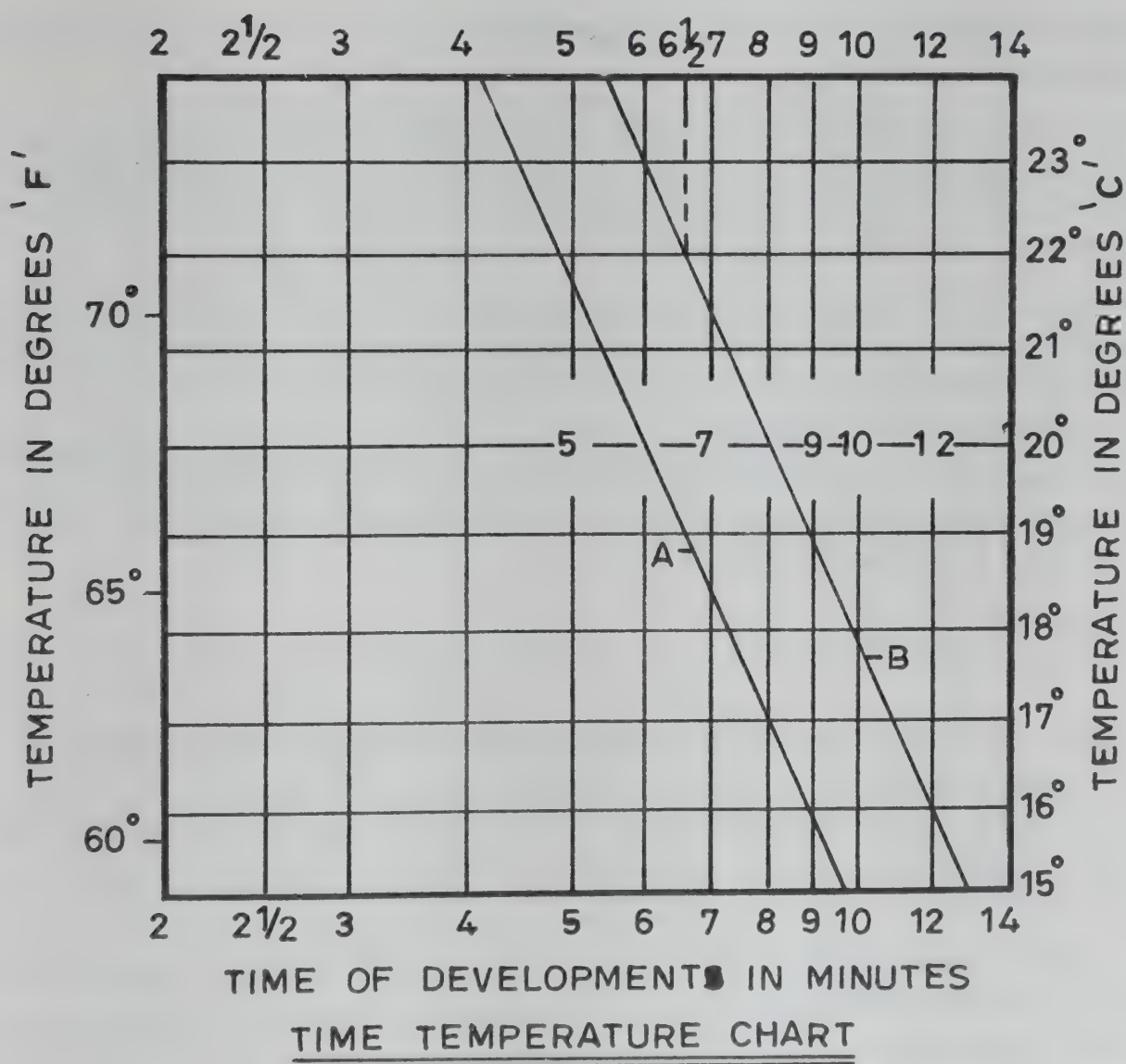


FIG. 6

4.6 Processing Roll Films of 3 Metre Length

The items required are: Spooling Device, Plastic Spiral Spool, Scissors, Dark-Room-Timer with luminous dial or with adhesive tape stuck on dial at the correct time for developing and a torch light.

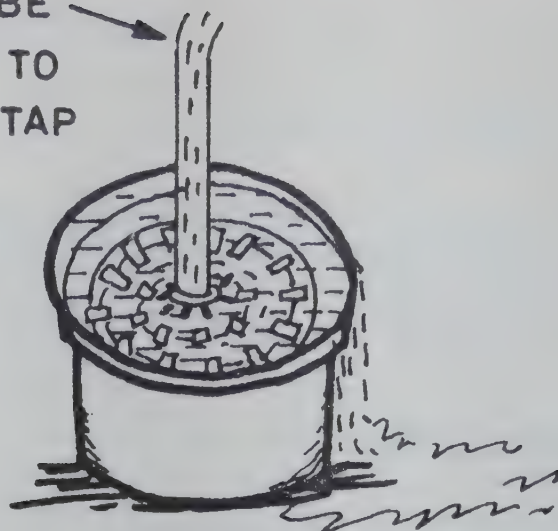
Processing is done as follows:

- i) Check the condition of spiral spool and load a good one on the spooling device.
- ii) Dry the hands well with a towel.
- iii) Switch off the light and make sure that no light is leaking through the doors and windows.
- iv) Fix the Plastic Spiral spool on the spooling device. Load the exposed film spool also. Un-wind a length of the film from the exposed film spool and pass it through the film guide. Attach the free end of the film on the plastic spiral spool using the film lock. (see Appendix VI, for pictorial presentation of the steps) Rest the film guide on the spiral spool and slowly wind the spiral spool using the knob on the spindle and guide the film into the spiral spool using two fingers of the free hand. When the film is fully wound to the spiral spool turn the last end of the film up, so that it does not touch the lower layer. If necessary, cut the last free end to facilitate this.
- v) Remove spiral spool from the spooling device (still in total darkness) and place it in the developer for processing.
- vi) Insert the spinning rod and rotate the spindle **anti-clockwise only** (in the direction of arrow for five seconds). Turn dark-room-timer knob and set it for the time marked by adhesive tape, continue turning of the spinning rod for another 25 seconds and thereafter 15 seconds every minute till the dark-room-timer rings.
- vii) Remove lid of developer tank and take the spool out after allowing the bottom end of the spool to be in contact with developer solution for five seconds, transfer the spool to rinse water tank, and spin the spool for 30 to 40 seconds.
- viii) Take the spool out, allow water to drain off for five seconds, transfer the spool to fixer tank, close its lid and spin for 30 seconds. Light can be switched on now. Keep the film in fixer for sufficient time (twice the clearing time and not developing time). Remove the spool, put it in the washing tank.

WASHING

In running water: Fix a rubber tube to the water tap and connect the other end of rubber tube to a glass tube (outside diameter 7 mm or slightly larger than 1/4" and/ 80 mm or 3 1/4") and push glass tube down central hole of the spindle of the spool and open the water tap. Note the approximate time it takes to fill the plastic tank and water to overflow (see Fig.7). If the time is two minutes, then washing time for film is 20 minutes (or 10 changes of water in tank), when temperature of water is between 25 and 30°C. Do not use water from the tap if water temperature is higher than 30°C as it may wash off the emulsion. If water temperature is between 15 and 25°C increase the estimated washing time by 50% and if the temperature is lower than 15°C double the time of washing (40 minutes or 20 changes of water). It is important to observe the number of changes of water and not the time of washing as removal of fixer is due primarily to changes of water.

RUBBER TUBE
CONNECTED TO
THE WATER TAP



WASHING THE FILM

FIG. 7

If tap water is too warm or when running water is not available, washing should be done with water stored in mud pots. About 30 litres of water would be needed to wash each roll. Sufficient water should be stored in a mudpot in the darkroom the previous evening to let it cool. Put the spool in the tank, pour water to cover the spool fully, spin the spool in anti clockwise in water for about 1 minute, throw out the water, pour fresh water and repeat the process eight to ten times.

TEST OF ADEQUACY OF WASHING

Without proper washing, films deteriorate on storage. To check adequacy of washing, take a very dilute solution of potassium permanganate in a test tube. Colour of solution should be slightly pink only, otherwise the test may not be satisfactory. Allow last six drops of water dripping from the spool to fall into the test tube. If there is no change in colour, the washing can be considered adequate.

DRYING

The washed films should be dried properly to avoid damage on storage. The following are the steps (see Appendix VI ■) for diagramatic presentation:

- i) Passing film through wetting solution
- ii) Transferring film to Roll Film Developing Frame (RDF)
- iii) Drying of film in Drier. If drier is not available the film can be dried in dust-free room.

4.7 Processing Single Films

The general technique of processing single films is similar to that of roll films and is done in the same tanks. The change is only in respect of transferring the films from the cassette on to a single film-rack. The standard processing equipment for films comprises:

- i) Single film-rack (SFR) for taking 12 single film
- ii) Detachable stainless steel grip.

The steps are the following (see Appendix VI ■):

- i) The single films are taken out of the light proof box (4.4, ii)
- ii) The films are loaded on to the SFR
- iii) The grip is clipped on
- iv) The SFR is placed in developer, rinsed in water, fixed and washed till the films are ready for drying (see 4.5 and 4.6 for details on processing time)
- v) The films are dried by placing SFR in drier or by hanging it in a dust-free room.

5.0 Preparation of Reference X-ray Film

It is very helpful to keep handy some standard X-ray films, for a quick comparison of contrast and density of each freshly developed film roll.

- i) Select X-ray film roll with fog level less than 0.4 (5.2.1). Expose the film using 20 mm aluminium phantom with KV values ranging from 70 to 120 in steps of 10 each and different token card for each exposure with automatic exposure control. Make six such exposures.
- ii) Remove the phantom and take six exposures with six different patients using same KV values and the respective token cards, as before.
- iii) Separately record MAS values when X-ray corresponding to each KV in each of the above exposures. Note in the Log Book the results along with the date of the test, the brand of X-ray film and the developer used.
- iv) Develop the film according to Time-Temperature graph, using fresh solutions.
- v) Use the reference film, after approval by the DTO, for detecting defects in each processed film. It may be necessary to prepare a fresh reference film whenever the brand of film or developer is changed.

5.1 Defects in Processed X-ray Films

Defects in X-ray films arise because of a variety of reasons relating to the equipment, quality of X-ray film, quality and freshness of developer solution, temperature of solution during development etc. The reference film (to be carefully preserved and shown to DTO, if occasion arises), makes it easy to locate defects and find reasons for them. In case the reason for the observed poor quality is not easily understood, write to the N.T.I. along with the following information:

- i) Brand and Batch number of the film,
- ii) Expiry date,
- iii) Brand of developer and age of developer solution used,
- iv) KV and MAS at which exposure was made and position of density control in case of manually controlled exposures,
- v) Tabulated results of reference film tests, as copied from the Log Book,
- vi) The reference film, a part of the processed defective film and one unexposed roll of the defective stock of films.

5.1.1 Checking Processed Film for Defects

Before placing a freshly processed film for DTO to read, XT should check:

- i) That patient token numbers on the film are in the same order as in the CFRF or Exposure Register. If not or when numbers are not clear, write with film marking pencil or Indian ink.
- ii) That there are no underexposed or overexposed frames, if seen find out the reasons. The technique with respect to patient's size, anatomical characteristics (a person with hunch back requires higher exposure) and film processing may need correction.
- iii) All positioning faults, closing the collimator too much will cut off lung fields. Wide open collimator will cause underexposure when automatic exposure is used because of direct beam falling on sensing area causing quicker termination of exposure.
- iv) Over-developing or under-developing by noting whether the card illumination area is too black or grey. Over developing of an under-exposed film increase film fog; though film density is higher the contrast is lost. Under-developing of over-exposed film causes loss of details; though contrast may be high the density is low.
- v) Physical damages to the film:
 - Nail and crimp marks on film, due to rough handling of the film,
 - Finger prints and yellow stains, by handling underdeveloped film with hands stained with fixer,
 - Reticulation caused by higher temperature differences between solution (keep temperature differences between developer, rinse water and fixer within 2°C),
 - Emulsion peeling off due to high temperature of the solutions or washing water or film used immediately after removing from the refrigerator.
- vi) That there are no artifacts:
 - Unaccounted dark areas caused by light leaks during loading, unloading or loose rivets in magazine,
 - A continuous line due to either uneven magazine pressure plate or damaged felt lining of magazine,
 - Parallel lines of uneven density caused by damaged secondary radiation grid inside the camera (grid must be changed),
 - Opaque objects in lung field such as buttons, ornaments or hair etc.,
 - Strange shadows caused by insects getting into camera or sitting on fluorescent screen (prevented by keeping cassette-port always closed),
 - Water marks left by drying of water drops on the film.
- vii) That there is no lowering of film density over the entire area of the film. This fault is due to one or more of the following reasons:
 - a) Fault in the operation of the automatic exposure (not applicable to X-ray units received from sources other than UNICEF).
 - b) Fall in efficiency of the fluorescent screen.
 - c) Defect in the optical system of the camera, due to corrosion or fungus growth. Among the above faults, the one due to automatic Exposure Control appears suddenly while the other two faults show up gradually.
- viii) Once again make sure that each film carries the date of exposure and Roll No. mark them when necessary.

5.2 Checking Freshness of X-ray Films and Chemicals

This check has to be done as soon as the stocks are received and periodically every three months thereafter.

5.2.1 Fog Level of Film

Cut about 12" of the unexposed X-ray film to be checked. Develop, rinse fix, wash and dry according to Time Temperature graph without exposing the film to light or radiation. Compare this piece of film with the standard (provided with the manual by placing both on a piece of white paper).

If the film is darker than the standard film, it has to be rejected because the fog level is higher than the acceptable level. The fog level of films must be checked and recorded whenever a fresh stock of films is received or when results with freshly exposed films start falling below expectation.

5.2.2 Utilisation of Film Stock

Use the earliest expiry date film rolls first, if their fog level is still satisfactory. At no time keep a stock of film rolls that has more than two separate expiry dates. Order the supplies carefully, if necessary twice in a year (3.5.1).

5.2.3 Checking Freshness of Chemicals

Exposure to atmosphere spoils chemicals. Examine all freshly received packings to ensure that company seals and cartons are intact and that chemicals are not leaking. Fixer absorbs moisture and deteriorates fast when in powder form.

5.3 Storage and Use of X-ray Films

5.3.1 Unexposed X-ray Film Rolls and Packets

These should always be stored in a refrigerator, to prevent deterioration (3.5.2). The stored film should never be loaded into cassette directly after taking out from refrigerator as moisture condensation on film layers of film stick together with the result that emulsion may peel off or film may tear at the time of loading. The film roll should be brought to the room temperature by keeping it outside the refrigerator atleast for 12 hours before it is used.

5.3.2 Filing of Processed Film Rolls

The X-ray film after being read by DTO/MO is kept in DTO's Office for final disposal of the patient till eighth day (e.g. Monday's film till next Monday). The film and the corresponding CFRF are collected by the XT on the eighth day.

Put the processed film in its container, mark its roll number(s) with Indian ink/suitable method on the bottom of the container and store them in serial order in a wooden tray (41 cms × 41 cms × 9 cms). The tray is divided conveniently into 100 partitions by running a thin wire through holes 4 cms above the bottom and 4 cms apart, on all the sides of the tray Fig.8.

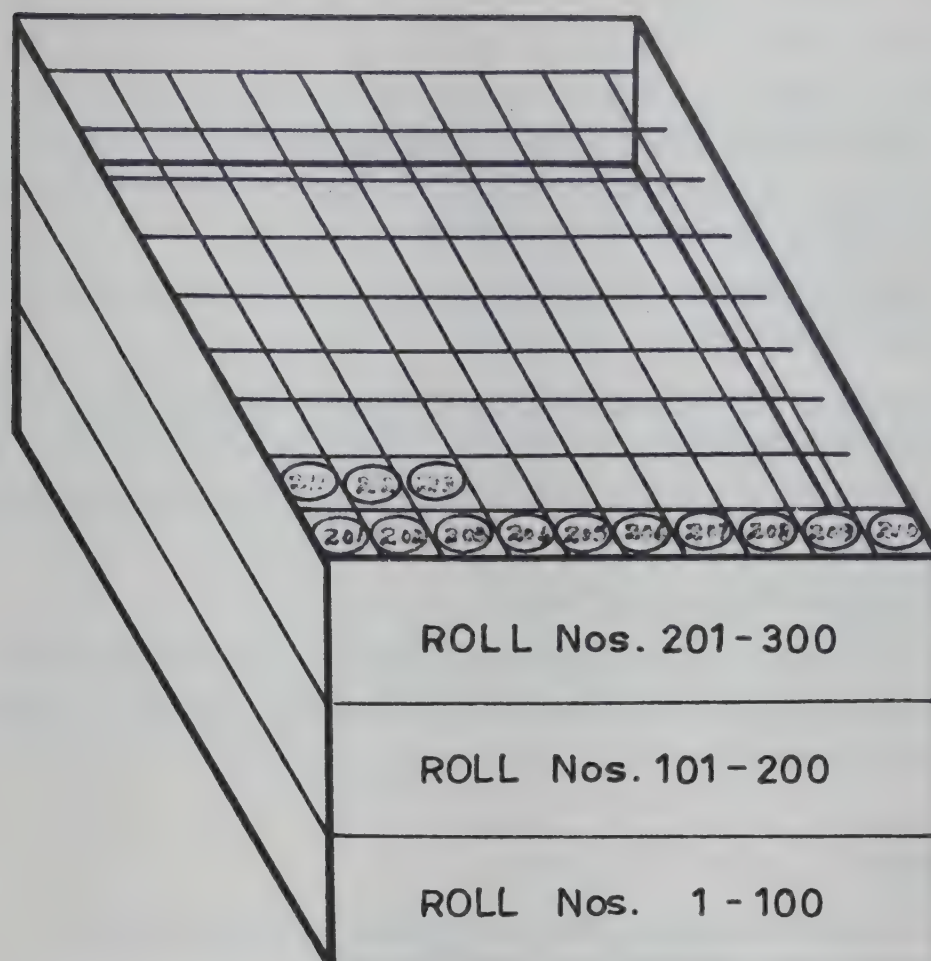


FIG. 8

The face of each tray should indicate the first and the last film roll numbers. Keep the trays in serial order, one on top of the other. The rolls are replaced in proper order as soon as DTO has finished reading them.

The processed film rolls have to be filed as above to permit easy access to old films for comparison. Dispose the films older than ten years as they would be of little interest for purpose of comparison.

5.3.2 Filing of Processed Single Films (Exposed in SFC)

Processed single films are kept in an envelope with date and the film numbers written on an envelope are filed in a box chronologically (datewise).

6.0 Maintenance and Repair of Equipment

6.1 Maintenance

6.1.1 X-RAY UNIT

The X-ray unit needs the following care:

- i) **DAILY:** Insert desiccator in camera port after the day's work and switch "off" the two main switches namely wall main and control.
- ii) **WEEKLY:** Clean X-ray unit with a dry rag and regenerate silica gel in desiccator if colour in indicator-window turns pink from blue. Regeneration is done by connecting it

to 230 volts AC power supply for six hours. The desiccator should not be inserted in the Odelca Camera when it is being regenerated or when it is **Not**.

- iii) **QUARTERLY:** Lubricate patient lift with Grease Gun through the nipple seen after lifting the platform up (look for the hole on the back of the lift). Check cassette for proper functioning, check thermometer as well as dark-room-timer for accuracy, against another thermometer and watch respectively.
- iv) **YEARLY:** Get the X-ray Engineer or Senior X-ray Technician from State Tuberculosis Centre to check that:
 - the Tube current values at 70,90 and 110 KVP correspond to correct colour codes in window x (3.3.1)
 - contacts in radiographic contactor, HR relay, motor lift relays and Iontomat relays are not pitted
 - collimator adjustment is correct
 - inter-connecting cables, plugs and sockets have proper contacts
 - camera lens, mirror and screen do not show fungus growth or signs of corrosion
 - film drier and refrigerator are functioning properly.

6.1.2 Roll Film Cassette

- i) Keep RFCs and film magazines free from grease, moisture and dust
- ii) Ensure that pressure plate in film magazine maintain their precision. For this, prevent dents or scratches on pressure plate caused by dropping or placing it on rough and dusty surfaces. When necessary, clean with a smooth dry cloth only, without any polishing material
- iii) Take care of the sliding surface of cassette frames in the same way
- iv) Never lubricate counting device (to prevent erroneous counting)
- v) Occasionally brush the velvet strips with a soft brush
- vi) Keep the glass plate in RFC-3 (an essential part of optical system) free of dust
- vii) Insert magazine carefully to prevent breakage or scratching of the glass surface
- viii) Never leave cassette without magazine with two spools or dark slide open. Magazine must have two spools.

6.1.3 Single Film Cassette

Handle SFC with the same care as for RFC (6.1.2) knocking against hard objects, damages by rough handling, scratches and dents, smudges and dust on pressure plates disturb the precision of film curvature, resulting in loss of definition in photofluorograms. Sliding surfaces may be lightly lubricated once a month with very light lubricating oil as used in sewing machines.

6.1.4 Processing Equipment

- i) Wash spiral spool with fresh water daily, once in a week clean it with detergent powder using a scrubbing brush (after film has been removed) and put it back on spooling device to avoid damage to it.
- ii) Use only one spool at a time. When the spool in use gets damaged, discard only the damaged parts and reconstruct with good parts removed from other damaged spools.

- iii) Scrub plastic tanks with cleaning powder at each change of solution. Wash with luke-warm water and dry.
- iv) Before putting fresh solutions into tanks, ensure that each tank has three steel balls and that central stump is intact. Also see that the light trap inside the lid is not loose or damaged and the spinning rod pin is intact.
- v) Once a week check spiral spool for cracks and damages and tightness of nuts. If replacement of flanges with appropriate R or L blades become necessary, unscrew nuts (nut A loosens counter clockwise and nut B clockwise) to put in good flanges (diagram) (see Fig. 9).
- vi) Check that film clamp holds the film well on clamping.
- vii) Wash the solution storage bottles, buckets and funnels with luke warm cleaning powder solution (do not use hot water) before using them for fresh solution.
- viii) Clean RDF after every use and check clips for proper holding of film periodically.
- ix) Wipe thermometer and dark-room-timer with dry cloth after use and keep them in a safe and dry place.

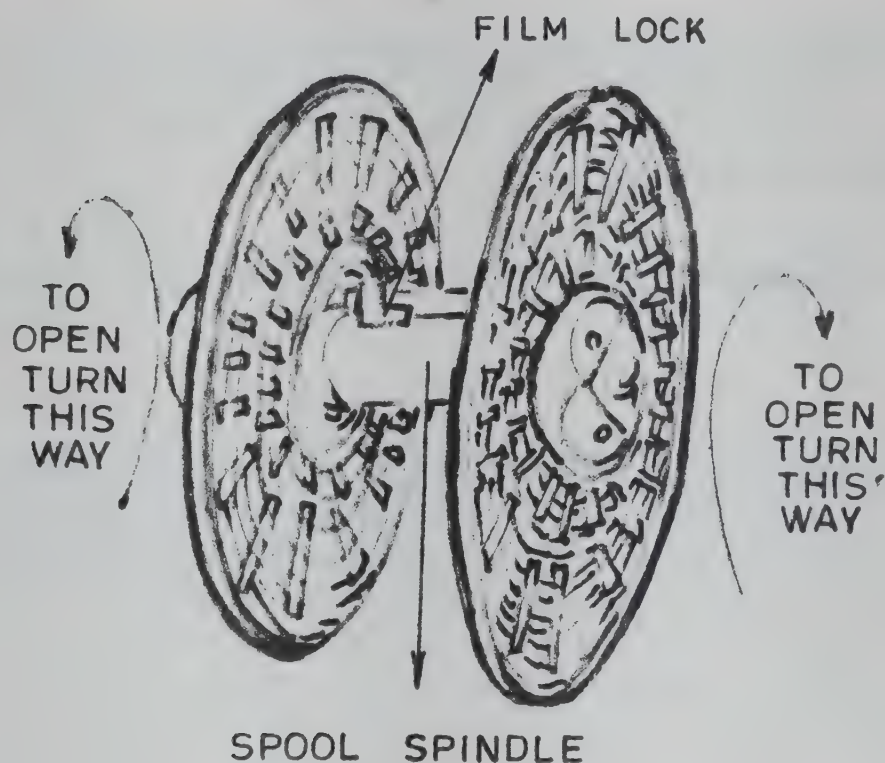


FIG. 9

6.1.5 Refrigerator

The refrigerator supplied with DTC equipment (as part of laboratory equipment) is shared by all the DTC sections. XT maintains the refrigerator by adjusting the thermostat knob at mark IV and defrosting the same as and when required. He fills the ice trays with water, whenever he uses up ice cubes. Fresh X-ray roll film, in their original packing film packets wrapped in a polythene bag are kept in the last but one compartment. Before starting a new refrigerator make sure of the operating voltage of the refrigerator. For 100-120 volts refrigerators suitable (300-500 volt ampere) step down transformers must be used to reduce voltage.

- i) In places where power supply voltage fluctuation is frequent, and voltage is high, refrigerator should be connected through a voltage stabilizer. Suitable model of Voltage Stabiliser would have the following characteristics:
 - a) The power supply to the refrigerator will be cut off when the fluctuation is very high and not within the limits of corrections of the Voltage Stabiliser.
 - b) The power supply of the refrigerator will be restored only after two to three minutes of reaching the correct value (i.e. the voltage stabilisers are fitted with Time Delay Switching facilities).
- ii) Defrosting

Defrosting at weekly intervals is essential. In humid places or during rainy months when thick ice forms quickly defrosting may have to be done more frequently. Whenever the layer of ice in the freezing compartment is more than 1 cm thick, defrosting is required. This is done by switching off the power supply and not by turning the thermostat knob. Keeping the door open will speed up defrosting. At the time of defrosting, all contents should be carefully removed and after defrosting inside should be wiped with a dry clean rag and the contents rearranged in the same order as before.

In the new refrigerators where automatic defrosting facilities are provided, this step need not be followed. Follow the instructions given along with such refrigerators.
- iii) Ice-trays

It is important that metal instruments are never used for levering out frozen ice trays from the freezing chamber. To prevent the sticking of ice trays in the freezing compartment apply a thin layer of oil to the bottom surface of ice trays, which will be in with the freezing compartment.
- iv) Condenser Coil

Keep the condenser coil dust free by brushing or blowing off the dust once a month.

6.2 Repairs

The overall responsibility for repair of equipment is that of State Government. It is one of the conditions of supply of equipment by the UNICEF/SIDA that these will be kept in good working condition. For X-ray equipment, some parts are supplied along with the unit and some are stocked in the N.T.I., Bangalore, to be provided depending on the availability (9.2). After each repair, all the spare parts received from the N.T.I. but not used and all the defective parts including fused bulbs and fuses are to be packed in the packing box in which spare parts were received from N.T.I. Whenever special instructions for packing are given, these have to be observed. The packages are returned to N.T.I. with a full list of spare parts used and a report on repairs (9.2).

6.2.1 X-ray Unit

- i) A report on condition of X-ray unit form (RCXU) should be filled in as per (9.2.1) and sent to N.T.I. as soon as a breakdown occurs or XT suspects the X-ray unit is not functioning as it should.
- ii) When spare parts are received from N.T.I., the box should be opened with a screw driver (lid will always be fixed with screws and not nailed). Remove the contents carefully, noting the packing order and the method of packing. Check each spare part for damages if any and report to N.T.I. immediately. Compare the parts with the enclosed packing list and see if all the items have been received. Repack the items in

the box in the same order in which they were received but do not fix the screws back on the lid.

- iii) Report availability of the spare parts to the DTO and request him to take necessary steps for getting the machine repaired.
- iv) After repairing of X-ray Unit a Report on Repair Form (RRF) is sent as per 9.2.

6.2.2 Cassette

Pack well damaged cassette and spare parts available in original card board box, if possible (if available in the DTC). Make a list of all the spare parts or count the different items and list them as cassette and so many spare parts. Despatch to N.T.I. or to firms undertaking repairs of RFC Cassette, duly insured for the maximum amount as on that date. Contact postal authorities in this regard.

6.2.3 Soliscope Viewer

When screw cap bulbs are not available locally for replacement, it may become necessary to fit milk-white 40 watts bayonet cap bulb. Following changes are to be made on the viewer for this purpose:

- i) Remove soliscope stand from viewer by releasing spring clips on the stand,
- ii) Remove fused bulb and remove bulb holder from viewer,
- iii) Remove cable from bulb holder and fix cable to a bayonet type brass holder (to be purchased locally),
- iv) After removing the brass ring meant for holding the shade, insert one of the two washers* (see Fig 10),
- v) Insert bulb holder with washer into the soliscope viewer,
- vi) Take the second washer through the back of the viewer (same opening through which fused bulb was removed) and insert it on bulb holder so that there is a washer on either side of the soliscope viewer body,

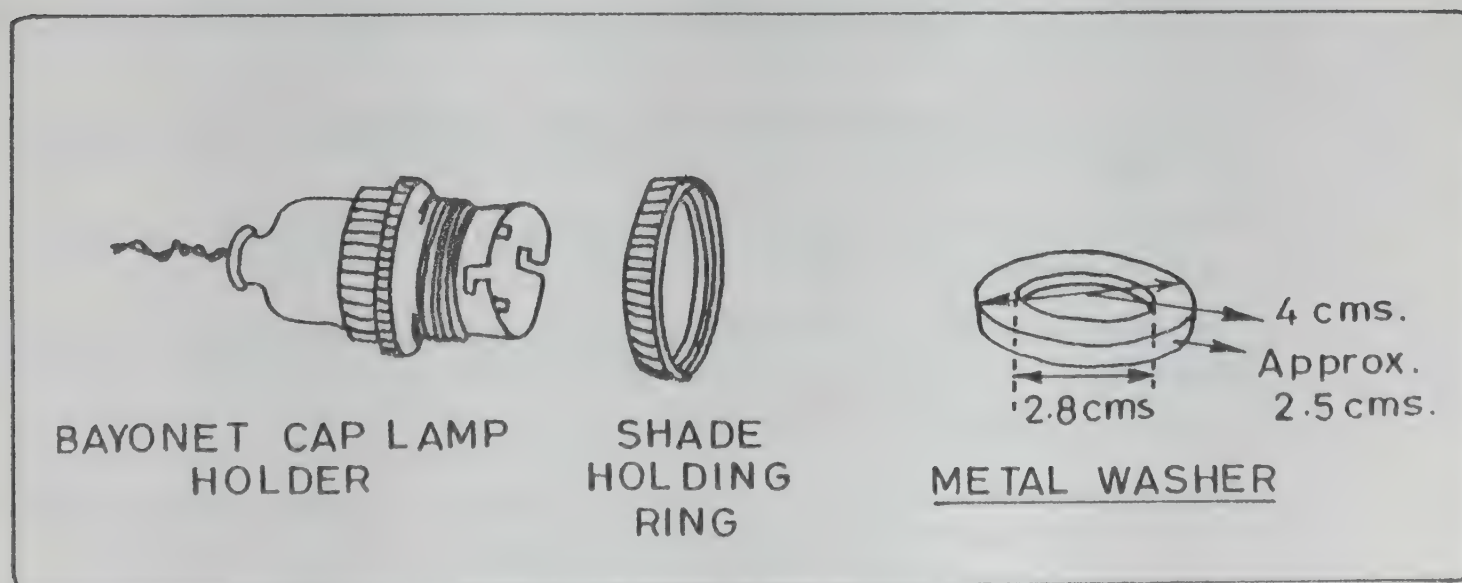


FIG. 10

- vii) Screw on the shade holding brass ring tightly,
- viii) Insert a 40 watts milk-white bulb bayonet type,
- ix) Fix the stand to the viewer.

*Washers are of approximately 2.5 mm thick, 4 cms, outer diameter and 2.8 cms inner diameter.

6.2.4 Desiccator

When the desiccator becomes unserviceable contact OLDELFT (FAREAST) LTD. Hyderabad.

6.2.5 Film Drier

When film drier goes out of order, request the DTO to arrange for the repairs.

7.0 Daily Check List

XT must personally attend to the following daily:

7.1 In X-ray Room

- i) See that X-ray Room is clean and tidy
- ii) Check all the cables and plugs for proper connections
- iii) Make sure that the line voltage selector switch on the control is in correct position (this step can be avoided, if knob of switch S.18 is removed by X-ray Engineer and stored away safely. Line compensator should be on the minimum position before switching "on" the X-ray unit
- iv) That collimator is kept closed when testing the unit except during Lontomat tests. X-raying of patients is started only after checking the X-ray unit (4.1.1)
- v) That cassette port of the camera is never left open
- vi) That intermediate piece is in position when RFC is being inserted into camera
- vii) That identity of each patient is established (4.2) before positioning him/her
- viii) That patient is instructed properly to hold breath and to keep steady during the exposure
- ix) That care is taken to see that hair and other X-ray opaque material are kept away from lung fields
- x) That DTC staff are not made to hold a patient during an exposure; let patient's relative do it, if necessary
- xi) That he/she stands well behind the radiation protection booth/screen while making an exposure
- xii) That damaged token cards are replaced immediately with new ones
- xiii) That token cards are kept in the order of persons X-rayed, make an exposure list (4.3.4) when card illumination is not functioning
- xiv) That switch S1 is switched off (0) whenever patients are not available. At the end of day's work the mains power supply is switched off

- xv) That desiccator window is checked to see if it needs reconditioning
- xvi) That desiccator is inserted into camera-port at the end of day's work.

7.2 In Dark Room

- i) See that dark room and dry bench are clean
- ii) That the rinse water is changed and developer and fixer tanks are kept covered when not in use
- iii) That age of the solutions - according to the number of days and or the number of films developed - is within the prescribed limits
- iv) That solution bottles are kept well stoppered (used solutions are not to be put into bottles holding fresh solutions)
- v) That the spiral spool is replaced on the spooling device after the film has been removed
- vi) That processed films are checked for faults systematically (5.1.1)
- vii) That all processed films are filed as per paras 5.3.2 and sub-sections
- viii) That fresh film for next day's work is kept out of refrigerator; fill ice trays of refrigerator and store water for washing (if necessary) before closing for the day
- ix) That appropriate entries are made in Log Book at the close of work; do not forget to enter abnormalities of functioning of equipment noticed each day.

8.0 Registration and Disposal of Out Patients

Procedure for registration of patient, X-ray reading, handling of connected cards and forms and disposal of patients are to be done as detailed below.

8.1 Registration

X-ray Technician registers outpatients sent by DTO/MO for x-rays with OP ticket. Only those patients x-rayed are to be registered in CFRF. Registration is done on X-ray Case finding Registration Form. A fresh form is used each day. Before starting registration for the day, all the entries that identify the form are filled on each sheet first. The same form continues for the day even though roll finishes and next roll is started. More than one sheet may be required as one sheet may not be sufficient for a day's work. However, token numbers run serially for that day.

A few centres may have to use one roll of film for two days. In this case, the roll number remains the same, date changes and token number starts with 001 every day.

In case the film is not used up, in two days then it will have to be cut and processed. In this situation, a new roll number and a date is given, token number start with 001.

In DTCs where the out-patient attendance is less than 40, the above procedure is employed. The top of the container should indicate the roll number(s) and date(s) for preserving them. If the daily out-patient attendance exceeds forty, then the assistance may be provided to XT on his request to DTO.

8.1.1 Case-finding Registration Form (CFRF)

The following instructions will help in filling the CFRF correctly:

Col.1: Enter date on which registration is being done,

Col.2: Enter film number. It means date of X-ray and token number/token number for that patient. Token number indicates the serial order in which patient shall be X-rayed (4.3.1 and 4.4.1),

Col.3: Enter full name of patient — not the pet name or half name. If patient attends with a Referring Slip, do not enter name given on the slip but question the patient carefully to ascertain correct name. Correct the name on the Referring Slip as well,

Col.4: Enter Father's name for all including married women,

Col.5: Enter age as given by the outpatients if the age given by patient is obviously incorrect, use own judgement,

Col.6: Enter M or F for male or female,

Col.7: Enter full address carefully. Make sure that the address given is correct by questioning the patient again, if necessary. The correctness of the address entered is very important as the subsequent default action if needed depends upon the correct address. The address should include the name of the Head of the Family, House No. and Street Name, and any prominent landmark in case of patients from city and name of the Village (Hamlet if necessary), Name of the Post Office and the Name of the Taluk or Name of the Sub-Division in case of rural patient. In case of married women, the name of the Husband should be entered (Wife of), in addition to the name of the Head of the Family, if he happens to be different.

Col.8: Enter name of the PHI, if outpatient has brought a Referring Slip (8.3). Leave it blank if it does not apply. Do not enter names of private practitioners or health institutions. Their Referring Slips are not relevant for record purposes, and therefore should not be entered,

Col.9: Enter "new" for out-patients attending for first time "old" for TB patients to be followed up. Enter "OBS" for out-patients placed under observation earlier (from identity card). These entries are important and should be made carefully,

Col.10: If available, enter film number/number of old or OBS patients (get from Identity Card/Referral Slips),

Col.11: If any out-patient is not X-rayed - enter "Not X-rayed" otherwise leave blank,

Col.12: These will be filled in by DTO and Statistical Assistant (SA). However, for old TB patients with identity card, case index number is entered in Col.12.

At the end of the day's work those registered in Col.9 as outpatients ("New" and "OBS") and "old" TB patients (i.e. for followup examination) are counted and entered separately in the first line of the middle box at the bottom of CFRF. Similarly, from Cols. 9 and 11, those X-rayed among these two categories are counted and entered in the second line of the box and those not X-rayed in the third line. Then XT checks that the entries in the first line are the same as the total of the other two entries in the two columns. X-ray CFRF is then signed by XT.

8.1.2 Registration when TB Clinic is Changed to DTC

When TB clinic is upgraded to a DTC, SA will guide XT on how to Register TB patients already on treatment in the X-ray CFRF.

8.1.3 Routing^{of} Case Finding Registration Form

- i) XT retains the completed X-ray CFRF at the end of day's work (8.1.1)/CFRF is collected from Registration Clerk,

- ii) XT puts up the CFRF along with referring slip/treatment cards of old TB patients examined for follow-up,
- iii) After DTO has finished reading the X-ray film, referring slips and Treatment Cards are collected by XT. XT hands over the Referring Slips to SA and old Treatment Cards to DTO. Films and CFRF are left with DTO for seven days,
- iv) X-ray CFRF and films are retained by DTO for seven days (8.1.1. Col.1). On 8th day CFRF and X-ray films are taken by XT for filing. XT checks (Col.11 of CFRF) for entry. If no entry is found for any patient he gets it filled by DTO/MO who reads the film

X-ray CFRF Routing (Refer Introduction to DTP page 45).

8.2 Handling of Referring Slip

These slips (see "Introduction to DTP", page 30) are used by MO of PHI to refer outpatients for X-ray examination (initial/followup) to DTC/XC. Results of examinations are sent back to MO of PHI on the same slips (XC are institutions other than DTC where X-ray as well as microscopy examinations and treatment are carried out).

Referring Slip Routing (refer " Introduction to DTP", page 49).

8.3 Issue of Outpatient Slip

Outpatient Slips with entries of name, age, sex are issued by DTO/MO to facilitate service being rendered to patients by different sections. DTC records should not be given to patients for this purpose.

On the Outpatient Slip, XT enters film number (from CFRF) and the date on which he/she has to come back for the result.

8.4 Disposal of Patients

For routing of patients for case-finding at DTC, (refer " Introduction to DTP", page 46 & 47)

8.5 Reading of X-ray Film Rolls

Reading of X-ray films is done by DTO/MO. But XT should be familiar with the codes used for X-ray reading as he has to arrange films, forms and cards for this work.

8.5.1 Codes used in X-ray Reading

DTO uses the following codes for X-ray reading and it is entered under Col.11 of CFRF for new X-ray films, as:

- i) N - Normal; OBS - Observation; PLEF - Pleural Effusion; TBHA - Tubercular Hilar Adenitis; TBP - Pulmonary Tuberculosis; NT - Non Tubercular; TI - Technically inadequate.
- ii) Codes for comparison of X-ray films on follow-up examination are : C - Clearance; I - Improvement; S - Stationary; D - Deterioration.

8.5.2 Arranging X-ray Films for Reading

- i) With the CFRF pertaining to the X-ray films to be read that day, XT first checks and completes the information on film numbers (Col.10) in respect of all old patients and OBS patients either from the District Tuberculosis Case-index or Treatment Cards or Patient identity card. Where there is a separate Registration Clerk, CFRF is obtained from him/her,
- ii) XT takes out the previous films of all old patients with Treatment Card of the patient,
- iii) He also obtains Treatment Cards from the Treatment Organiser of all old TB patients on treatment and new sputum positive patients of the previous day,
- iv) XT ensures that Referring Slips of referred outpatients have been received from the Laboratory Technician with the results of sputum examination duly entered on them,
- v) The relevant CFRF, the new and old X-ray films the old Treatment Cards and the Referring Slips are now placed on DTO's desk,
- vi) After DTO has finished reading the film, XT gives back the Treatment Cards to Treatment Organiser, the Referring Slips to Statistical Assistant. He leaves CFRF and exposed films on DTO's table for seven days. He collects the CFRF on 8th day and also films for verifying completion of entries and also for filing. He hands over the CFRF to **To.**

~~Referring Slips~~

9.0 Records and Reports

Records have to be maintained for all activities of the X-ray Section with regard to equipment (breakdown, repairs and supplies), work done and the results.

9.1 Records

Following are the Records handled by X.T.

CFRF (8.1), Treatment Card (8.1.3),

Referring Slips (8.2), Outpatient Slip (8.3),

Token Cards, Exposure Register and

X-ray Log Book.

9.1.1 Token Cards

These are essential for identifying photofluorograms. The sizes of token cards to be used in different kinds of X-ray machines are shown in the Appendix I. Token cards are marked in bold figures from 001, 002 serially to 050 or more, according to the maximum number of patients attending for X-ray examination on any day.

XT uses one Token Card for each patient, starting with 001 at the start of the day and serially thereafter. After the photofluorograms have been taken, the card is removed and stacked separately in the order of exposures. If more than one exposure was taken for the patient, this fact is recorded in the CFRF or exposure register (9.1.2) by a number within brackets after the token number. At the end of the day/roll XT may (e.g. 34(2)) use the cards in the stack, along with entries in CFRF to identify exposures, if card illumination device has not functioned (4.3.4).

When there is a Registration Clerk, he/she issues the Token Cards to the patients after registration. XT collects the Token Cards from the patients and uses them for entry in Exposure

Register (9.1.2) and for taking the photofluorograms. At the end of the day, the Token Cards are returned to the registration desk for ~~use~~ next day's use.

9.1.2 Exposure Register (See Appendix I for the format)

This register is required when XT is not himself registering patients. The purpose is to have a reliable record of the order in which X-ray pictures have been taken so that mistakes due to faulty operation of card illumination device can be corrected. The token numbers are recorded in the sequence in which X-rays are taken. Exposure registers are not needed when single films are used as indicated in 4.4 or when CFRF is filled by XT.

9.1.3 X-ray Log Book (Appendix I)

The X-ray Log Book of 300 pages (foolscap size) is maintained for the following information:

- i) An inventory of X-ray equipment, spare parts, accessories and all non-expendable items used in X-ray Section with full particulars and dates of receipt (first 20 pages of the Log Book),
- ii) The date on which X-ray equipment was installed,
- iii) Tabulated results of all tests with respective dates carried out on the X-ray unit, reports of damages and repairs, results of tests performed after each repair, etc., (pages 21 to 50 of the Log Book),
- iv) The day-to-day activities, including dates of preparation of solutions and their quantity, stock of X-ray films on hand, faults of the X-ray unit or accessories are recorded in 12 columns in the remaining pages.

The columns of the Log Book from page 51 onwards are filled as under:

Col.1: Date

Col.2: Number of persons X-rayed (last token number minus those not X-rayed)

Col.3: Add the X-rayed of Col. 2 to previous total in Col.3 the approximate number of persons previously X-rayed and continue adding as above. When X-ray tube is changed, start with 'Zero' in Col.3 and start a fresh numbering

Col.4: Enter the number of technically inadequate exposure (col.11) from X-ray CFRF after DTO has read the film

Col.5: Number of rolls/single films used

Col.6: Date of preparation of ~~solutions~~ solutions. When one solution is prepared in excess of other, mention quantity of each solution separately

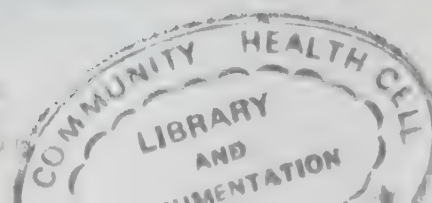
Col.7: Date on which fresh solutions actually used

Col.8: Progressive total of film rolls/single films developed in fresh solutions are entered in Col.7

Col.9: Actual number of film rolls/single film boxes in stock minus the number of film rolls used (col.5) are entered example: January 1993 - 125, June 1992 - 11, Total 136

Col.10 & 11: Decrease stock of developers fixer progressively and separately as and when solutions are used.

NOTE: Whenever new stock of films or chemicals are received add them to the stock on hand in red ink to get the final stock.



Col.12: Records any abnormalities noticed in the X-ray or dark room equipment, during each working day. If space is insufficient, information of Report On Condition of X-ray unit (RCXU) can be used (example: Test No.15 Abnormal noise when lift is raised).

9.2 Reports

XT prepares the report on condition of X-ray unit ~~and Report on Repair of X-ray unit~~ whenever necessary.

9.2.1 Report on Condition of X-ray Unit (RCXU)

Filling the RCXU is the first step to test the broken down unit systematically in order to get the equipment repaired. The format is given in the Appendix.

9.2.1.1 General Instructions

- i) Read all the instructions carefully before filling RCXU
- ii) All questions must be answered
- iii) Do not use additional words in answering questions, except for question 5d, 7 and 17 where appropriate entries have to be made. Relevant additional remarks may be put at the end of the report and if additional paper is used, copies should be prepared and despatched along with RCXU
- iv) Read instructions under "line tester" (Appendix 7) carefully, and follow them when the line tester is used
- v) After XT has filled in the report, he submits it to DTO who examines it carefully, countersigns it. XT then arranges for its despatch as follows:
 - 1st copy to N.T.I. for getting spare parts.
 - 2nd copy to State Tuberculosis Centre/Health Directorate, if it has an X-ray Engineer/Firm's branch that normally attends to repair of equipment.
 - 3rd copy (office copy).

9.2.1.2 Guide Lines for Answering Questions (see Figures 2 & 3 Under 3.3.1)

- Question No.1:** If switch S.18 is not in the correct position, correct it and proceed with the test (correct position is 380 Volts 50 Cycles and never 60 Cycles).
- Question No.2:** Check each plug for damage. See that they are fixed at correct points. If cables are crushed or plugs are damaged, give correct description of the cable "additional remarks".
- Question No.3:**
- a.** If voltmeter is not indicating voltage, check main fuse of the power supply and the control desk. Replace defective fuses. If power supply is absent contact the local Electricity Department. Check the line cable connection to plug (big flat one at the bottom of the control) and see that connections are intact (use line tester, whenever necessary).
 - b** If blower fan is not working, open the control cover after disconnecting the five plugs (i.e. K2, K3, G2 and G3 and Iontomat cable). Check fuse U6 behind the control at right lower end (looking from the back of the control) and replace if defective.

c. If both lamps B₁ and B₃ (Fig. 2) are not glowing, the thermal contact in the tubehead needs testing with the line tester. Remove K3 plug from the control end and while keeping it on at the tube-head on test continuity between pin numbers 6 and 7. If there is no continuity, the testing of the X-ray unit should be resumed after a few (3 to 4) hours later to allow time for the thermal contact to close (thermal contact may open up due to over heating of tube-head, especially in summer).

Question No.4:

If answer is no, contact the local Electricity Board to test the power supply voltage in the X-ray room. Report the reading of the voltage indicated by their voltmeter. If control voltmeter needle is not moving according to line compensator operation, enter in the remarks space that 'line compensator' (knob 'V') is not functioning.

Question No.5:

a. Distinguish the sound of rotating anode from that of blower fan (blower fan is 'on' as soon as control is switched 'on' but rotating anode sound is heard only when exposure switch S.22 is pressed).

b. If pilot bulb B₄ is not glowing (card illumination system is probably defective; therefore check your last film roll for card numbers), replace the bulb from spares or with a 6.3 volts radio pilot lamp of the same type. To get access to bulb B₄, lift the plastic cover that is only clipped on, change bulb and press cover down. If B₄ still does not glow, it indicates that either of the bulbs inside the camera or interconnecting cable or 12 volts supply are defective. Mention that the bulb B₄ inside the control panel was checked; bulb B₄ has been replaced by a good one.

c. If normal voltage drop is not seen it indicates defect in X-ray unit. Whether it is "Normal" or not is decided by previous observations during daily check of the X-ray unit and is indicated by the colour code marked at the beginning of RCXU.

d. This answer must be carefully reported. The position (colour band) on which the voltmeter stops briefly during the test is to be recorded.

Question No.6:

a. This is to find out if tube filament is lighting (if you cannot hear the relays working it may mean that the tube filament is not lighting).

b. If mA meter does not deflect (and there is no voltage drop), it means X-rays are not being produced. But if there is voltage drop, mA meter might be defective. This can be tested by finding out whether the film in the cassette is exposed or not by developing it after an exposure.

Question No. 7:

It is important that the tube current adjustment (mA adjustment) is made correctly according to the power line resistance. It is indicated by test No.5 and adjustment of switch S.17, if correctly done, will give mA values as under 3.3.1, vi.

Question No. 8:

If pilot lamp B₂ continues to glow after ten seconds, it indicates that insulation of lontomat circuit is not satisfactory. It is some times possible to improve insulation by making "voltage test" (No.5) 2 or 3 times. This helps to dry up the moisture in lontomat circuit. Repeat lontomat test (No.7) - if result still shows that lontomat is not working satisfactorily, Report. If fault is only with lontomat the X-ray unit can still be used by adjusting the timer. This is true also if question No.9, 10, 11 below indicate that lontomat is not working satisfactorily.

Question No. 9: If it is giving a prolonged exposure, the defect may be due to lontomat cable or chamber.

Question No.10: If prolonged exposure is not possible and pilot lamp B₂ is not glowing after the test then lontomat working cannot be relied upon. Use manual exposure control (though lontomat may appear to be working alright, results will not be satisfactory).

Question No.11: This test judges adjustment of lontomat sensitivity control (the values of mAs and KVP are for Agfa Gevaert Scopix GS film with Agfa Gevaert high contrast developer. For other films and developers refer to Appendix). IV.

Note: For the remaining tests do not use switch S.24

Question Nos.12-14: Occasionally the pilot lamps may not go 'off' due to improper position of the dark-slide, defective or absent intermediate piece, or defective switch of the RFC. Test with duplicate cassette (if available) to make sure that RFC Switch is not defective before sending 'RCXU'. If RFC Switch is defective the cassette alone should be sent by post parcel for repairs (6.2.2).

Note: Some of the later models of Siemens X-ray unit is supplied with lift type (SLT) (Odelca). If lift motors of this type are defective refer to the additional page

~~9.2.2 at the end of the manual.~~

Q. NO 9 on Page 45

Question No.15: If lift motor is not running, check both fuses on the cover box of the lift motor and replace if found defective. If unusual noise is heard when motor is working, grease through the nipple and if the noise still persists, remove the fuses and work the lift manually till it is repaired. If lift fuses are blown out, try with a new set of fuses but make sure that Control Voltmeter is correctly adjusted to "V" mark before operating the motor.

Question No. 16: Failure of the collimator functioning may cause unaccountable shadows or edges on developed films. Check collimator shutter operation and for correct positioning with respect to outlines of camerahood.

9.2.2 Report on Repairs of X-ray Unit (RRF)

This report is prepared by the person who repairs the X-ray unit. The form is filled as under:

- i) Enter date and number of the RCXU under "reference"
- ii) Complete details of the work done must be given under the three headings of the report. Three copies of the report should be made. Despatch the first copy to the authority authorising repairs (with a note regarding number of days taken for repairs), 2nd copy to NTI/DGHS for assessment of repairs as well as accounting of spare parts used and the third is the office copy
- iii) XT checks the X-ray unit thoroughly (3.3 and sub-sections) to certify the repairs
- iv) XT also notes the X-ray Engineer's next camping station and duration of his stay there. In case any defect is noticed during his stay in the next camping place, he should be contacted there for immediate action.

FORMAT OF TOKEN CARD (ACTUAL SIZE)
145 mm

54 mm	TOKEN NUMBERS TO BE WRITTEN HERE	51 mm
<div>115 mm</div>		

THE FORMAT OF X-RAY LOG BOOK (NON-ACTUAL SIZE) — TO BE DRAWN IN THE FOOLSCAP SIZE BOOK

Date	1	2	3	4	5	6	7	8	9	10	11	12	Remarks
No. of persons X-rayed													
Progressive Total of persons X-rayed													
No. of Technically inadequate pictures													
No. of film rolls used													
Date of preparing solution & quantity													
Date of change of developer in tank													
No. of film rolls/single film developed in current solution													
Stock of unexposed films with expiry dates													
Stock of Developer													
Stock of Fixer													
Remarks													

NATIONAL TUBERCULOSIS PROGRAMME

REPORT ON CONDITION OF THE X-RAY UNIT (SIEMENS SERIOPHOS-5) (RCXU)

Control Serial No.

Date of Installation

Report No

State

Name of the District:


Colour seen through the hole on the top of switch S17 is (colour)

Put " (√) " mark in the correct box

"Yes"

"No"

- | | | |
|--|---|---|
| 1. Is the line selector switch S18 (Fig.2 under 3.3.1) in correct position as per voltage and frequency? | <input style="width: 50px; height: 20px;" type="checkbox"/> | <input style="width: 50px; height: 20px;" type="checkbox"/> |
| 2. Are all cables and plugs (line and inter connecting cables from control desk to camera, tube and the lift motor) without damage and in correct position? | <input style="width: 50px; height: 20px;" type="checkbox"/> | <input style="width: 50px; height: 20px;" type="checkbox"/> |
| 3. Switch on the control and observe: | | |
| a) Is Voltmeter indicating voltage? (If "No" check line fuse U1 and U2) | <input style="width: 50px; height: 20px;" type="checkbox"/> | <input style="width: 50px; height: 20px;" type="checkbox"/> |
| b) Is the blower fan of the tube head working? | <input style="width: 50px; height: 20px;" type="checkbox"/> | <input style="width: 50px; height: 20px;" type="checkbox"/> |
| c) Are the last two pilot lamps B ₁ & B ₃ on the control glowing? (film advance and card change lamp). If "No" check U6 fuse inside control. | <input style="width: 50px; height: 20px;" type="checkbox"/> | <input style="width: 50px; height: 20px;" type="checkbox"/> |
| 4. Can the voltmeter be adjusted to the delta (∇) mark on the voltmeter with the line compensator? (Meter "V" and knob "V" Fig.under 3.3.1) | <input style="width: 50px; height: 20px;" type="checkbox"/> | <input style="width: 50px; height: 20px;" type="checkbox"/> |
| 5. Turn operation selector switch (S1) to "V" and timer (MZ) to "V" position & press exposure switch (S22) | | |
| a) Is the rotating anode running? | <input style="width: 50px; height: 20px;" type="checkbox"/> | <input style="width: 50px; height: 20px;" type="checkbox"/> |
| b) Is the (B ₄) pilot lamp (card illumination glowing briefly during this test)? | <input style="width: 50px; height: 20px;" type="checkbox"/> | <input style="width: 50px; height: 20px;" type="checkbox"/> |
| c) Is the voltmeter indicating normal voltage drop? | <input style="width: 50px; height: 20px;" type="checkbox"/> | <input style="width: 50px; height: 20px;" type="checkbox"/> |
| d) To what colour is the voltmeter needle dropping back to?
.....(colour) | <input style="width: 50px; height: 20px;" type="checkbox"/> | <input style="width: 50px; height: 20px;" type="checkbox"/> |

6. (A) Turn the operating switch (S1) to radiography position “” and the timer (MZ) for 0.10 sec, kilovoltage selector (R5)/70 KV and make an exposure by pressing the by pass switch (S24) and exposure switch (S22) simultaneously and observe the mA meter and the voltmeter: (If necessary test twice; See Fig.under 3.3.1)

a) Can you hear relays inside the control working?

☐
☐

b) Does the mA meter show deflection (kick)?

☐
☐

c) Does the voltmeter show voltage drop?

☐
☐

(B) Can you hear the radiographic contactor working? loud noise indicating exposure (AS relay working)

☐
☐

7. Adjusting the line compensator to “(∇)” mark. Set kV to 70. Set timer to 1.0 second. **Check colour code switch S17 for correct setting** according to colour code indicated by test No.5 above. Make an exposure.

Reading of the mA meter is mA


8. Turn the operating switch (S1) to lontomat position “-I I-” and turn the timer to the lontomat position “-I I-” and press the exposure switch (S22) — observe

After about 10 seconds, does the “B2” pilot lamp “-I I-” (mark) remain “on” when radiographic contactor starting and stopping sound is heard

“Yes”

“No”

☐
☐

9. Turn the timer (MZ) to 1.2 sec., operating switch (S1) to radiographic position “” collimator fully opened, press the bypass switch (S24) and the exposure switch (S22)

a) Is the exposure taking place?

☐
☐

b) Is the mA meter showing a very brief kick?

☐
☐

c) If the mA meter is not giving very brief kick, does it give prolonged exposure?

☐
☐

10. Repeat the test (9a) with collimator shutter closed. Do you get a prolonged exposure?

☐
☐

11. Open the shutter fully, insert 20 mm aluminium phantom, turn kilovoltage selector (R5) to 70 kV and make an exposure. Compare the lontomat exposure sound with the exposure sound taken on the timer setting at 20 mAs. (see 9.2.1 - Q11)

Does the radiographic contactor timing sound similar in both the cases, or does the lontomat exposure sound appear to be

longer


same

shorter

☐
☐
☐

Caution: DO NOT PRESS bypass switch (S24) in the following tests:

12. Insert the serial cassette in the camera with **INTERMEDIATE PIECE** in position (set timer to 0.10):

Is the exposure possible with exposure switch (S22) only, when operating switch (S1) in the radiographic position "  " after advancing the film, changing card and pulling dark slide out?

"Yes"

"No"

☐
☐

13. Turn the film winding handle and bring it back to the original position. Does the (B₁) pilot lamp go off?

☐
☐

14. (A) Put card into the card tray and push back the card tray. Pull out the dark slide: Does the (B₃) pilot lamp now go off?

☐
☐

(B) Repeat above test (14A) but without card in card tray: Does the (B₃) pilot lamp now go off?

☐
☐

15. Operate the patient lift up and down (Always adjust line compensator correctly to " (∇) " delta mark). Report whether:

"Yes"

"No"

a) The voltage drop on the control negligible?

☐
☐

b) Are you hearing unusually loud sound?

☐
☐

c) Does the motor lift fuse blow out repeatedly?

☐
☐

d) Does the patient platform move up and down?

☐
☐

e) If patient platform is not moving, is motor shaft rotating?

☐
☐

16. a) Is the collimator shutter functioning properly?

☐
☐

b) Is the collimator bulb glowing?

☐
☐

17. The following items of accessories are defective: (List items found defective and nature of defects found. If necessary, additional sheet of paper can be used for giving details)

Mention any other additional remarks and observations, if noticed: (If space is insufficient attach additional sheets)

Forwarded by
(Signature of DTO)

Filled by X-ray
Technician
(Name)

Place:

Date :

SPECIFICATION OF SET OF X-RAY EQUIPMENT/ACCESSORIES TO BE SUPPLIED TO T.B.
CENTRE DIRECTLY BY THE X-RAY FIRM

Sl. No.	Quantity	Equipment Details																					
1	One	SIEMENS X-ray Diagnostic Unit ERGOPHOS 3M/ 4M/4 Full Wave Rectified - 2 pulse generator, at 415 V, AC input (across 2 lines) of a 3 phase power supply.																					
		<table><tr><td>Main impedance</td><td>mA</td><td>kV</td></tr><tr><td>4 ohms or less</td><td>75</td><td>100</td></tr><tr><td>0.9 ohms or less</td><td>160</td><td>100</td></tr><tr><td></td><td>100</td><td>125</td></tr><tr><td>0.6 ohms or less</td><td>240</td><td>80</td></tr><tr><td></td><td>200</td><td>100</td></tr><tr><td></td><td>100</td><td>125</td></tr></table>	Main impedance	mA	kV	4 ohms or less	75	100	0.9 ohms or less	160	100		100	125	0.6 ohms or less	240	80		200	100		100	125
Main impedance	mA	kV																					
4 ohms or less	75	100																					
0.9 ohms or less	160	100																					
	100	125																					
0.6 ohms or less	240	80																					
	200	100																					
	100	125																					
2	One	Static Balancer 25 kva.																					
3	One	B.E.L. X-ray Tube Unit - THX - 1 Incorporating:																					
4	One	SIEMENS X-ray Light Beam Collimator Full field illumination, stepdown transformer.																					
5	One pair	B.E.L. High Tension Cables 8 M length with 'O' terminals and cable fitting accessories.																					
6	One	SIEMENS X-ray Tube Column Stand, Ceiling free.																					
7	One	X-ray Barrier ABC Type with lead glass window (Indian Make).																					
8	One	Film Drying Cabinet, suitable for 10 roll films and large size 25 films - 230 V, 50 Hz, AC operation.																					
9	One	Dark room timer with alarm bell 0-60 mins. (Indian Make).																					
10	One	Dark Room Floating Thermometer (Indian Make).																					
11	One set	Radiographic Cassettes (Indian Make) dimensions. IS Specifications, comprising: 3 Nos. size 12" x 15" 3 Nos. size 12" x 10" 3 Nos. size 10" x 8"																					
12	One set	Radiographic Intensifying Screen (Indian Make), comprising 3 Nos. size 12" x 15" 3 Nos. size 12" x 10" 3 Nos. size 10" x 8"																					
13	One set	Stainless Steel Film Hangers (Indian Make) comprising: 6 Nos. size 12" x 15" 6 Nos. size 12" x 10 " 6 Nos. size 10" x 8"																					
14	One	Dark Room Safe Light 7" x 5" (Indian Make)																					

15	One	Film viewing box for viewing a single large film 230 V. 50 Hz. AC (Indian Make).
16	One	SIEMENS Vertical Chest Stand, floor mounting with scale.
17 a	Three.	Developing Tanks stainless steel (Indian Make) for film processing capacity 3 gallons, one for film processing capacity 10 gallons.
17 b	Two	Stainless Steel lids for 3 gallon tanks.
18	Two	Film developing Rack hanger suitable for 70 mm single films (Indian Make).
19	Two	Film developing hanger suitable for 3 metre roll film (Indian Make).
20	One	ODELCA 70 mm roll film camera with straight hood, type 70 SL-1 including screen and card holder.
21	One	CRD anti-diffusion grid.
22	Two	RFC-3, 40 exposure serial cassette, hand operated, holds three meter roll film of 70 mm, equipped with 2 interchangeable film magazines with two empty spools.
23	three	16 Y, spare magazine for serial cassette RFC-3.
24	One	SFC-4 single exposure film cassette for 70 × 70 mm sheet film.
25	One	DSC-4 desiccator unit.
26	One	SFD, safety device to prevent operational errors.
27	One	LST-SH, elevator stand for SL-1.
28	Two	PLV-2, soliscope viewer.

CHECKING OF EROGOPHOS — 4M UNIT FOR PROPER FUNCTIONING (see Fig. 11)

Switch on the control desk by depressing switch No. 2 and adjust the voltmeter with the help of line compensator correctly to the Red line marked on the meter No.16 (V/mA meter) (Note : V/mA meter (16) longer line on the upper scale indicates one mA for each, on the lower scale indicates 25 mA for each longer line and red line indicates 225 volts).

Making an exposure with odelca camera and the SFD-Depress switch (No. 7) to select operation of the unit with odelca camera and observe the glow of red pilot lamp on the SFD panel. Insert a loaded RFC 3/SFC 4 into the Camera Port taking care to see that the intermediate piece is in position. Adjust the four position switch on the SFD panel to serial/single position depending upon the cassette in use (off, single, serial MCS). Pull out the dark slide and advance the film. Pull out the card tray and insert a token card into the card tray and push it back. Then observe directly the green pilot lamp glowing indicating that the odelca camera is ready for operation. (By now the red pilot lamp goes off).

Set kV (Kilovoltage) at 70 and mA (Milliampere) at 100 (small focus) with timer setting at 0.10 sec. Observe whether green pilot lamp is glowing on the control, which indicates that the unit is ready for releasing the exposure. Make sure that voltmeter needle is still at red line before releasing the exposure. Now release the exposure by pressing switch No. 8 half way to prepare the circuit and press the switch fully to release the exposure, simultaneously observe the exposure indicator (red pilot lamp) No. 15 glowing briefly during exposure.

Similarly make sure that the card illumination indicator on the SFD panel white indicator lamp (make the test twice) glowing after releasing Exposure switch (No.8) On termination of the X-ray exposure the red pilot lamp on the SFD panel glows which indicates the blocking for the next exposure. For making next exposure all the above steps such as advancing the film, changing the token card should be carried out.

Though there are separate controls for selecting kV, mA, and time of exposure unless these selected values are so matched that they are within the ratings of the X-ray tube, only then the ready indicator (green pilot lamp) on the control panel glows indicating the unit is ready for releasing the exposure.

Set kV at 70 and mA at 100 (small focus) and timer at 1.0 sec. Make an exposure and observe the V/mA meter needle deflection which should tally with the mAs value shown in the mAs display window (No.15). If it does not tally the inference is that the unit needs further calibration. The calibration should be done during installation/while servicing the X-ray unit by Firm's X-ray Engineer. Similar tests should be carried out for the remaining mA settings (80, 160, S.F. 160, 200 of large focus).

Exposure technique and card-illumination adjustment

The following steps are required whenever the card illumination needs adjustment. Adjust card illumination screw (R11) (situated on the SFD panel by removing the dust cap) to the minimum position (maximum anti clockwise position). Now make six equal divisions on semi circular mark between the minimum and maximum positions of R 11 screw on the panel.

Make six exposures by using the following technique with six persons of average thickness (22 cms) by changing the token card for each exposure and keep mA at 100 and KV at 86 with 30 mAs (0.3°sec) for ORWO film. After each exposure shift the screw R 11 from one division to next division. For Scopix RP2/Indu Films (Agfa Gevaert) film set KVP to 86 and mA to 100 with 12 mAs (0.12 Sec.) Make similar set of six exposures as per the above procedure.

The above technique was used in combination with Agfa-Gevaert high contrast developer/Indu developer. The above mentioned technique can be used as guidance for different combination of films and chemicals available in D.T.C. and also make a few exposures with different techniques and compare to arrive at the acceptable standard film. After verifying the processed test film in consultation with the D.T.O, adjust the R-11 (SFD) screw to the required position. Out of the six exposures made, select the acceptable film frame as standard one for future reference. Make an entry in the X-ray log book about the position of the screw in the remarks column.

X-ray tube centering in relation to odelca camera

Switch on the collimator and adjust the vertical shutters in such a way that a narrow beam of vertical light covers both plus (+) and dot (·) marks on the camera hood. Now close the horizontal shutters such that it correctly covers the plus (+) mark. Now adjust the X-ray tube so that the dot (·) is visible and fix the tube arm at the position for M.M.R. Work.

NATIONAL TUBERCULOSIS PROGRAMME
REPORT ON THE CONDITION OF THE X-RAY UNIT
ERGOPHOS-4M WITH ODELCA CAMERA 70 MM

REPORT NO. :

Name of the District :

Control Serial No :

Date of installation :

State :

NOTE: Numbers in brackets are as shown in figure

ERGOPHOS-4M

	"Yes"	"No"
1. Are all cables and plugs (interconnecting cables to odelca camera, safety device, collimator & lift motor) without damage and in correct position?	<input type="checkbox"/>	<input type="checkbox"/>
2. Switch on the control by depressing (2) push button switch and observe :		
a) Do you hear the sound of relay contactor?	<input type="checkbox"/>	<input type="checkbox"/>
b) Is V/mA meter (16) indicating voltage?	<input type="checkbox"/>	<input type="checkbox"/>
c) Can you adjust the voltage to the red mark with the help of line voltage compensator V (3)? (If no for (b) and (c) above check U1, and U2 35 Amps fuses which are located on the side panel of the H.T. transformer; and also check all the 3 fuses of the power lines located inside the switch board).	<input type="checkbox"/>	<input type="checkbox"/>
3. Check lift motor, SFD and collimator for their functions after depressing push button (7) (if no check U4 fuse 6 Amps inside the control)	<input type="checkbox"/>	<input type="checkbox"/>
4. Can you hear the humming sound inside the control? (If no check U5 fuse 6 Amps and U1 fuse 4 Amps inside the control)	<input type="checkbox"/>	<input type="checkbox"/>
5. Depress push button (4) Set radiographic kV 70 Set radiographic mA at 100 0.10 radiographic timer at 0.10 sec. Depress exposure release switch (8) half way down and observe :		
a) Is the voltmeter needle coming back to zero? (If no probably the X-ray tube filament circuit may be defective)	<input type="checkbox"/>	<input type="checkbox"/>
b) Is the rotating anode running ? (If no check U201, fuse 6 Amps and U202 fuse 2 Amps individually one after the other if necessary and replace without interchanging the fuses)	<input type="checkbox"/>	<input type="checkbox"/>

		"Yes"	"No"
	c) Is rotating anode stopping soon after releasing the exposure release switch (8)? If no check U203 fuse 2 Amps.	<input type="checkbox"/>	<input type="checkbox"/>
6.	Depress exposure release switch (8) fully and observe :		
	a) Does V/mA meter (16) show deflection?	<input type="checkbox"/>	<input type="checkbox"/>
	b) Can you hear the sound radiographic contactor AS relay working? (If no check U101 timer circuit fuse of 0.5 Amps).	<input type="checkbox"/>	<input type="checkbox"/>
	c) After the exposure does V/mA meter 16 again indicate voltage?	<input type="checkbox"/>	<input type="checkbox"/>
7.	ODELCA camera — CAUTION Insert the serial cassette with film and intermediate piece and depress auxiliary switch (7) set SFD to serial position.		
	Set kV at 70 on knob (9)		
	Set mA at 100 on knob (11)		
	Set timer at 0.10 sec on knob (12)		
	a) Is red pilot lamp ON SFD glowing?	<input type="checkbox"/>	<input type="checkbox"/>
	b) Is exposure possible with exposure release switch (8) after advancing the film, changing the token card and pulling out the dark slide?	<input type="checkbox"/>	<input type="checkbox"/>
8.	a) Turn the film winding knob and bring it back to original position; does the red pilot lamp go off on the SFD control?	<input type="checkbox"/>	<input type="checkbox"/>
	b) Put token card into the card tray and push back the card tray. Pull out the dark slide and observe.		
	i) Does the Red pilot lamp now go off on the SFD control?	<input type="checkbox"/>	<input type="checkbox"/>
	ii) Repeat the above test but without the token card, does the Red pilot lamp now go off?	<input type="checkbox"/>	<input type="checkbox"/>
	c) During each of the above three operations; do you hear the relay sound inside SFD control? (Report individually in the remarks column).	<input type="checkbox"/>	<input type="checkbox"/>
	d) Make an exposure and observe carefully whether the white pilot lamp on the SFD control (card illumination bulb) glows?	<input type="checkbox"/>	<input type="checkbox"/>
9.	CAUTION Are all 6 switches on the rear side of the camera in upward position? (Always adjust the line compensator to red mark on the V/mA meter). Operate the patient lift up and down and report.	<input type="checkbox"/>	<input type="checkbox"/>

a) Is voltage fluctuation on V/mA meter of the control negligible?

b) Are you hearing unusually loud sound?

c) Do the switches trip off?

d) Does the patient platform move up and down?

e) Is the safety foot switch below the patient platform working?

10. Double slot collimator

a) Are the collimator shutters function properly?

b) Is the collimator bulb glowing ?

11. The following items of accessories are defective. (Make a list of items found defective and nature of defects noticed. Use additional sheets for details).

Filled by X-ray Technician
Name

Forwarded by
(Signature of D.T.O)

Place :

Date :

BRIEF DESCRIPTION OF THE FUNCTIONS OF EACH CONTROL OF THE ERGOPHOS 4 M:

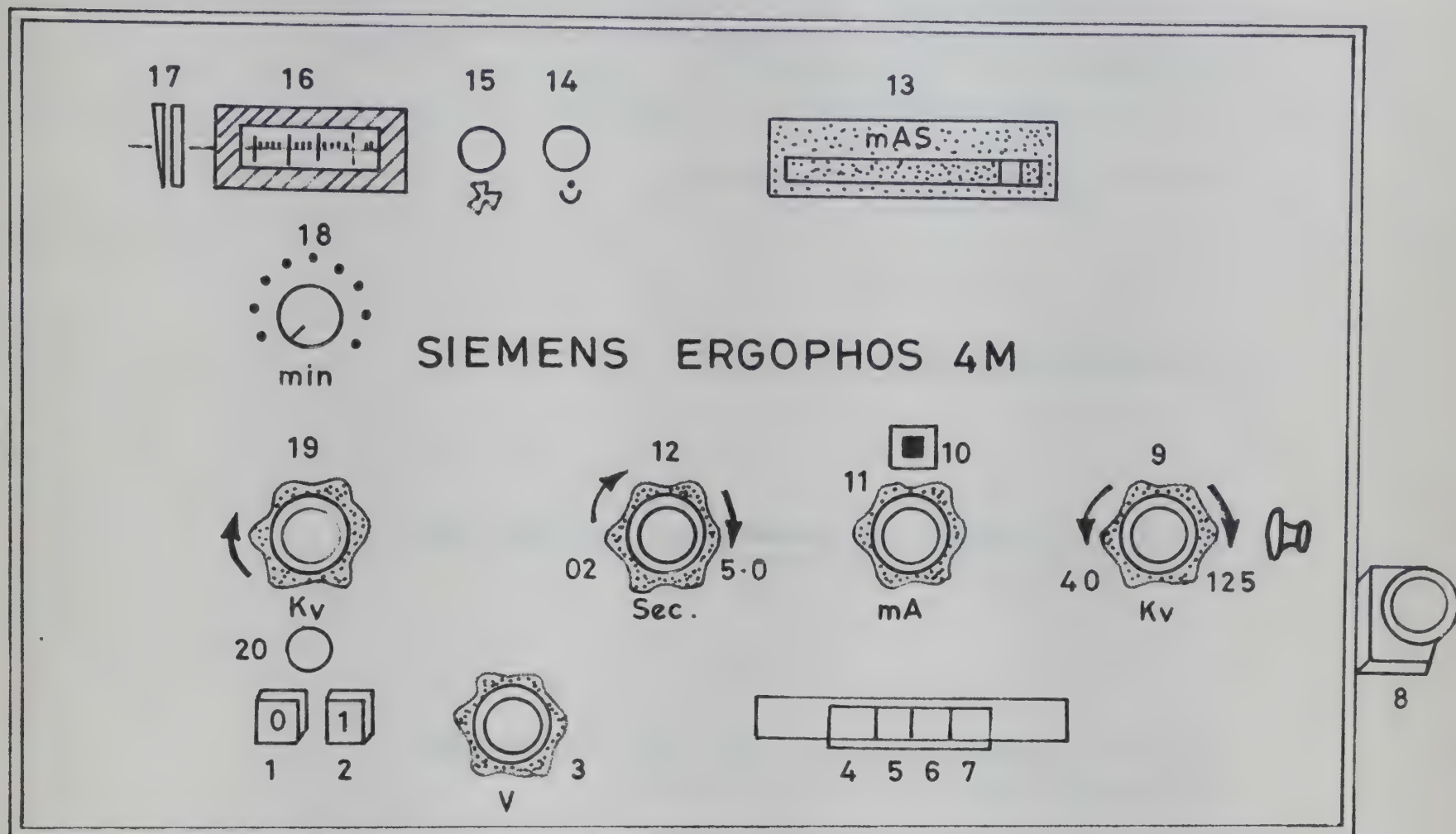


FIG.11

- | | |
|--|---|
| 1) Push Button Mains OFF Switch. | 13) mAs display, mAs selected can be read directly. |
| 2) Push button Mains ON Switch. | 14) Ready Indicator (Green). It glows to indicate that apparatus is ready for operation. |
| 3) Mains voltage compensator. | 15) Exposure Indicator (Red). It glows during radiography. |
| 4) Radiography with push button exposure 8. | 16) Meter for :
i) Voltage compensation (Red Line).
ii) Indicator of fluoroscopy tube current.
iii) Indicator of Radiography tube current. |
| 5) Operation from spot film device. | 17) Fluoroscopy Tube current control. |
| 6) Radiography with Bucky release with exposure release switch 8. | 18) Fluoroscopy total time spent and warning buzzer. |
| 7) Operation from special equipment. | 19) Fluoroscopy KV control. |
| 8) Exposure release switch to initiate exposure from the control desk. | 20) Fluoroscopy switch. |
| 9) Radiographic kV selector. | |
| 10) Register selector to indicate small focus/large focus. | |
| 11) Tube current selector (mA). | |
| 12) Exposure time selector for radiography. | |

REPORT ON REPAIRS OF X-RAY UNIT

Name of District State :
Name of the Service Engineer Wiring Diagram No.
Job done with reference to RCXU, Report No. & Date.

1. The following repairs have been carried out :

2. The following spare parts have been used :

3. The following damaged and unused spare parts have been returned to DTO for returning to NTI :

4. The following repairs have still to be carried out for which additional spare parts listed below are required.

Signature of the Service Engineer

The report as above has been checked and found correct.

Signature : X-ray Technician of the Dist. Centre

Signature : DTO with Seal

To be filled in triplicate :
2 copies to be handed over to DTO—

One of which should be sent along with returned spare to NTI & one copy to be filed in the DTC.

1. Copy for the file of the
Service Engineer Firm of
.....

FORMAT OF DAILY EXPOSURE REGISTER (To be Prepared in a Student's Exercise Note Book)

In remarks column enter number of exposures made when more than one exposure is made on any token number

[illegible]

LIST OF FURNITURE FOR X-RAY SECTION OF DTC

1)	Large Table with drawers	....	1
2)	Chair with arms	....	1
3)	Benches for patients	....	2
4)	Almirahs	....	2
5)	Wooden work bench in dark room covered with oil cloth	....	2
6)	Woden stool for patients (12" × 9" × 10") height	.....	1

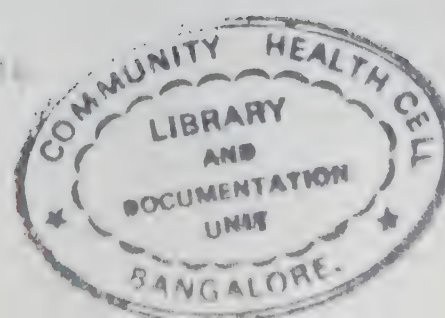
Sl. No.	Item	Quantity
Components of the X-ray Equipment Siemens Seriophos-5 X-ray Unit consists of the following:		
1	Control for X-ray generator	1
2	X-ray generator (tube head) with aluminium filter	1
3	Light beam collimator (as fitted part of the X-ray tube head)	1
4	Odelca Camera 70-VII-U or 70-SL-1 with card tray, Iontomat chamber, fluorescent screen and stationery grid	1
5	Interconnecting cables with plugs and junction box	1
6	Line cable with plug	1
7	Roll film cassette RFC-2 for 70-VII-U camera and RFC-3 for 70-SL-1 camera with intermediate piece	2*
8	Single film cassette SFC-U for 70-VII-U camera or SFC-4 for 70-SL-1 camera	1
9	Desiccator with plug and cable	1
10	20 mm aluminium phantom	1
11	Radiation protection booth with patient lift	1
Dark Room Accessories		
1	Circular developing tanks of 2 litre capacity (type RDT) - plastic/steel	4**
2	Plastic spiral spools (type PTW)	6
3	Film spooling device (type RSD)	1
4	Soliscopes viewers	2
5	Film drying cabinet	1
6	Darkroom timer	1
7	Film frame (type RDF)	6
8	Film clips	24

The above items are supplied as part of the X-ray unit.

* For supplies made later than 1973 only one cassette is provided

** When stainless steel tanks are supplied only 1 is provided (write to NTI for detailed instructions for film processing)

05341



In addition, the following items are to be procured by the DTC from the State Government budget.

Sl. No.	Item	Quantity
1	Plastic buckets (20 litre capacity)	2
2	Photographic thermometer (10°C to 50°C) (one for use and one for stock. Additional stock to be procured as soon as the thermometer in use is broken so that there will be at least one thermometer for use always)	2
3	Pair of Scissors	1
4	Mixing rod plastic or long plastic spoons	2
5	Plastic bottles 2 litre capacity (4 each in different colours one for fixer and the other for developer, dark colour for developer)	8
6	Plastic funnel (one each in different colours similar to bottles)	2
7	Stainless steel vessel 2 litre capacity having a diameter of 16 cms exactly (for controlling the temperature of the solutions)	1
8	Graduated measuring jar in 1000 cc capacity	1
9	Torch	1
10	Brushes one hard and one soft	1 each
11	Dressing gown for patients (in different sizes)	3
12	Plastic hair caps in different sizes	3
13	Chest calliper	1
14	Lead letters and numerals	5 sets
Essential Tools to be provided from the DTC Budget		
1	Screw driver 8" long	1
2	Screw driver 3" (small tip)	1
3	Electrician's cutting player	1
4	Adjustable spanner 10"	1
5	Components for making line tester (for details see Appendix VII)	1 set

PRECAUTIONS TO BE TAKEN TO AVOID UNNECESSARY EXPOSURE TO X-RAYS.

X-ray unit should be installed centrally in the X-ray room to reduce scattered radiation (see Fig. 1 under 3.2.1)

A. The DTC Staff

The following instructions are to be followed to avoid DTC staff from getting unnecessary exposure to X-rays;

- (1) The X-ray room should not be used for any other purpose while the X-ray equipment is in use.
- (2) Staff of the DTC, other than the X-ray technician should not enter the X-ray room while the patients are being examined..
- (3) The staff of the DTC should not be called upon to position the patient or hold weak or non-cooperative patients. This work should be entrusted to patients' relatives.
- (4) The X-ray technician should stand well behind the radiation protection booth and observe the patient through lead glass window only, while making exposures.
- (5) The door of the radiation protection booth should be closed before exposure (applicable for SIEMENS Seriophos-5 unit).
- (6) If the lead glass is broken it should be replaced immediately by requisitioning for it from NTI or the source from which the radiation protection screens have been procured.

The patients should be properly instructed to hold the breath & X-ray Technician should see that he/she is able to follow instructions properly before exposures are made. Similarly, X-ray Technician should also make sure that the patients position has not altered before the exposure is made. These steps prevent unnecessary exposure to radiation by the X-ray Technician due to secondary radiation as well as due to un-wanted exposures (repeated exposures due to faulty technique or positioning of the patient).

B. Patients

Though it will be an advantage to allow patients to observe how they should behave while being radiographed too many patients should not be allowed to wait in the X-ray room while waiting for examination. Patient next to be examined alone may be permitted in.

Positioning the patient correctly and giving him a "practise" on holding the breath will to a great extent reduce patients shaking during the exposure, thereby reduce the need for repeating the exposure. Before pressing the exposure button make sure of the following:

- (1) The collimator is adjusted correctly and area is not extending below the Iliac Crest (by adjusting the lower leaf of the collimator properly). When the bulb of the collimator is not working make use of the colour coded out-lines on the camera hood and coloured dots by the side of the collimator shutter-control levers
- (2) Choosing the highest kV at which exposure can be made according to the contrast desired by the DTO

(3) The patient has not moved from the set position and the voltage of the X-ray unit (line voltmeter on the control) has not altered from the set value.

NOTE: Process the film strictly according to 4.5 of this Manual to avoid repeating exposures.

The above precautions will avoid unnecessary radiation to the patient as well as reduce the scattered radiation.

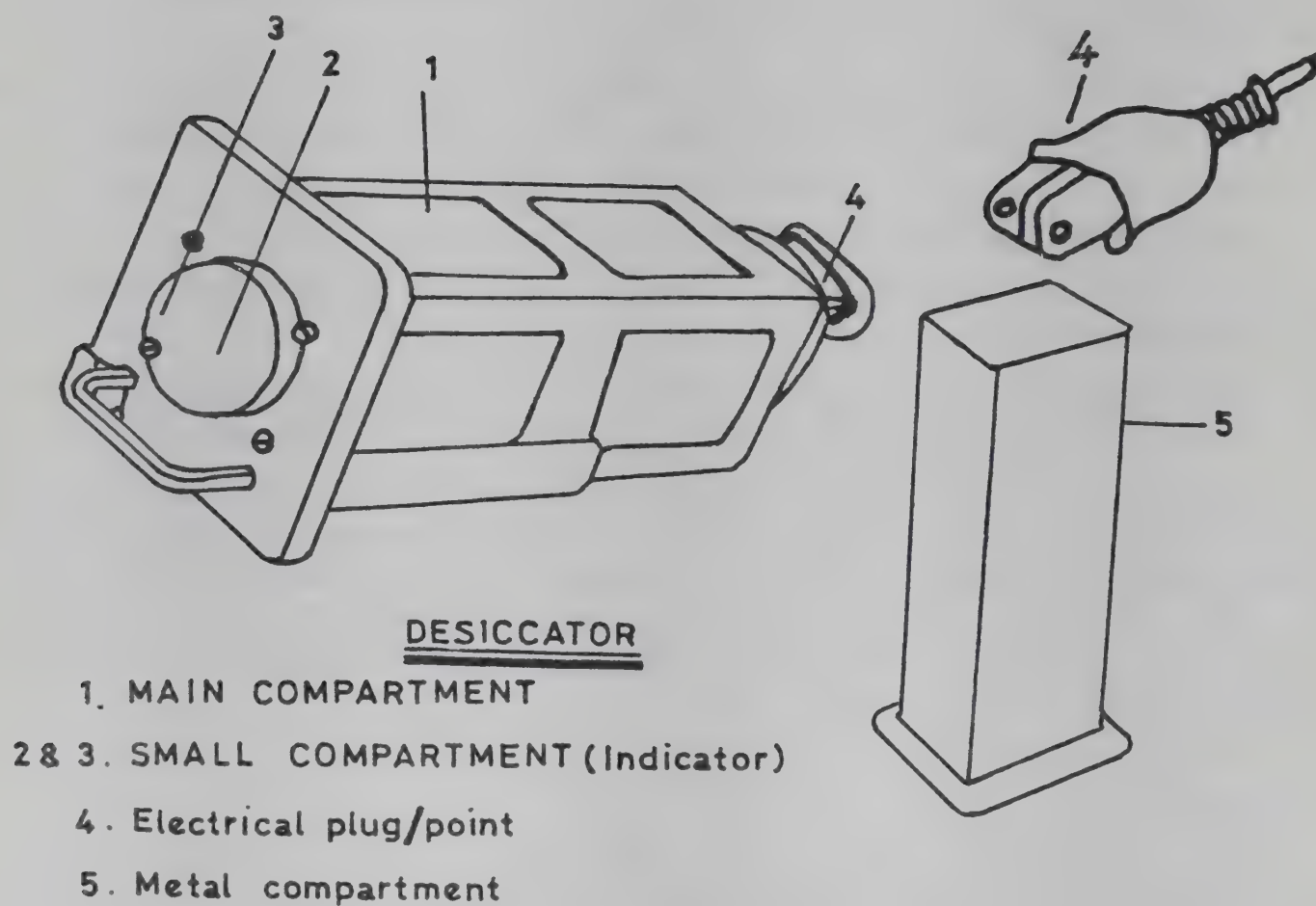


FIG. 10 A

APPENDIX - IV

ADJUSTMENTS REQUIRED IN EXPOSURE VALUES WHEN DEVELOPER IS CHANGED

Satisfactory film density depends among other things on the sensitivity of the film as well as the activity of the developer. Maximum number of films which can be developed in a given solution and period during which solution can be used is indicated in 4.5. These instructions should be followed fully. The brand of developer and film used and temperature of processing influences the quality of the radiograph and following data is given to ensure that results of even standard are achieved even when film or developer brands are changed or when temperature variations occur.

Adjustments for temperature variations:

When temperature of the solution cannot be brought exactly to 20°C, duration of the film in developer should be adjusted. Diagram under 4.5 (Fig.6) indicates the adjustment in developing time required for film which gives satisfactorily results with 6 minutes development at 20°C. If the solution used in D.T.C. is one which require higher or lower developing time at 20°C, corresponding correct developing time for higher or lower temperatures with such a solution can be found as shown in the following example:

If the correct time of development recommended for the Brand of developer in use is 8 mts at 20°C and correct time for developing the film at 22°C is required processed as follows:

On the time temperature graph (Fig.6) locate the point 8 mts on 20°C horizontal line. Draw a line parallel to time temperature line of 6 mts (slanting line at 8 mts. point as shown in the diagram. Locate point of inter section of 22°C horizontal line to the 8 mts. line now drawn and drop vertical line parallel to the time line till it meets either the top or bottom horizontal lines. Reading of the time. In the example shown it is 6 1/2 mts.

Adjustments for change of brand of the developer:

The exposure given to film will probably require alteration as the developer is changed. The table below indicate proper developing time.

TABLE

Brand code	Brand Name	Correct developing time at 20°C for Agfa Gevaert film/Indu films
A	Agfa Gevaert T 209 developer/Indu developer	6 minutes
B	Johnson P.Q. developer	8 minutes
C	“ Ordinary	8 minutes
D	M & B 300	9 minutes
E	M & B 340	8 minutes

Directions for use of Time Temperature Chart

In para 4.5 Fig. 6, Time Temperature Chart is given. The line 'A' of chart indicates how the time of processing the film is to be adjusted when temperature is different from 20°C. The line 'A' is for a developer whose correct processing time for the film in use is 6 mts. It may be necessary to

process a film whose developing time is greater or less than 6 mts. at 20°C. Similarly DTC may have a developer whose developing time for the film in use is different at 20°C.

Case I: *When Correct Developing Time at 20°C is 6 mt*

When the developer temperature is higher than 20°C or lower than 20°C trace along the line 'A' till the horizontal line corresponding to the temperature of solution at which the processing is to be taken is reached. Let us say it is 22°C. The line 'A' crosses the 5 mts line at 22°C. This can be seen by the vertical line corresponding to 5 mts. crossing the horizontal line corresponding to 22°C, on which the line 'A' is almost meeting. Similarly for lower temperature, line 'A' crosses 10 mts. line when temperature is 15°C. For other temperature values draw a vertical line from point where line 'A' crosses horizontal temperature line on which film is to be processed.

Case II: *When solution temperature combination require developing time other than 6 mts. at 20°C*

If the film, developer combination require a developing time other than 6 mts at 20°C. then a line other than line 'A' represent condition for film processing. This line is to be drawn on this chart by first ascertaining correct developing time for solution film combination at 20°C (example: see Table 'A' of Appendix IV).

If time of development is 8 mts. at the point 20°C, horizontal line meets 8 mts. vertical line draw a line 'B' parallel to 6 mts. line 'A'. Now line 'B' has to be used instead of line 'A' for this solution to correct the developing time according to temperature.

Example: When solution temperature is 22°C trace the line 'B' to the point where it crosses 22°C horizontal lines. At junction point draw vertical line (dotted line Fig. 6) and ascertain the developing time.

Draw lines as required according to time temperature requirements of developer film combination.

APPENDIX - V

PROCEDURES FOR LOADING AND UNLOADING CASSETTES

NOTE: The loading and unloading of cassettes should be done in total darkness.

(A) ROLL FILM CASSETTES RFC.2/RFC.3

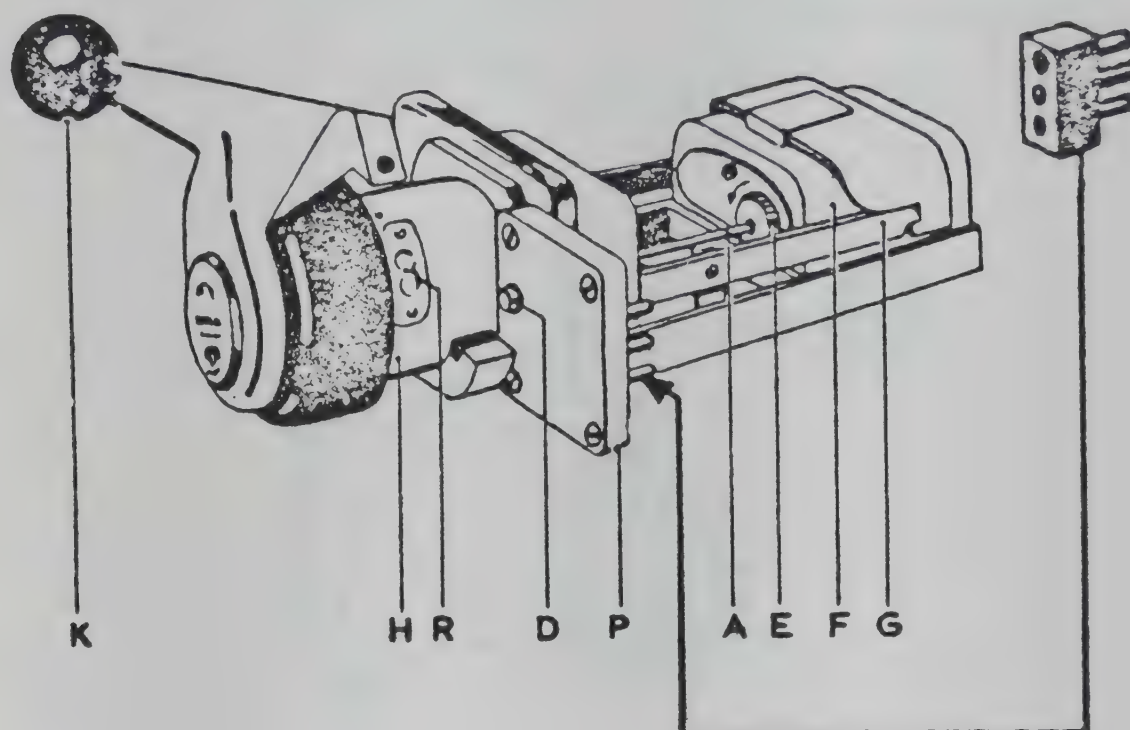


FIG. 1 A

Fig. 1(a): Parts of the Cassette: K – film winding-knob, H – housing with internal mechanism, R – counting device, with T – catch, P – terminal plate with pins numbered 1,2,3; A – winding spindle, G – yoke, F – film magazine, E – clutch on film magazine, D – terminal contact.

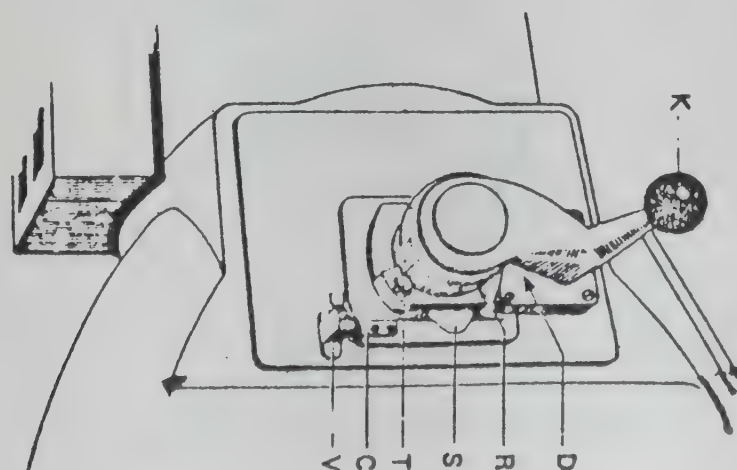


FIG. 1 B

Fig. 1(b): S – dark slide, T – catch of the counting device, C – cam, V – spring catch (on the camera). R – counting device, D – terminal contact, K – film winding knob.

NOTE: RFC-3 cassette has a glass plate in the film gate (not visible in the figure). Care should be taken to see that this plate is not cracked or scratched due to rough handling. Before loading the film, this plate should be cleaned (free of dust and any other foreign matter) R.F.C-2 cassettes do not have glass plate.

Film spools have a round hole on one of the flanges and square hole on the other. While loading the cassette round hole of the film spool is inserted first into the magazine spindle.

Loading of the cassette is done as follows:

- (1) Cassette is kept on a table free of dust and grit with a fresh film in its container in a convenient location on the table.

CAUTION Film to be used should be kept out of the refrigerator for atleast 12 hours before use.

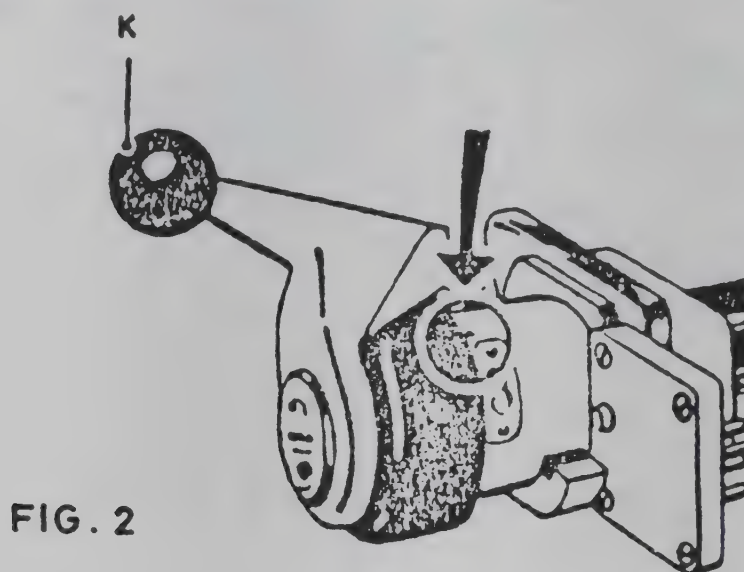


FIG. 2

- (2) Advance the film winding knob "K" half way through the film winding stroke (see above) holding cassette with the other hand.

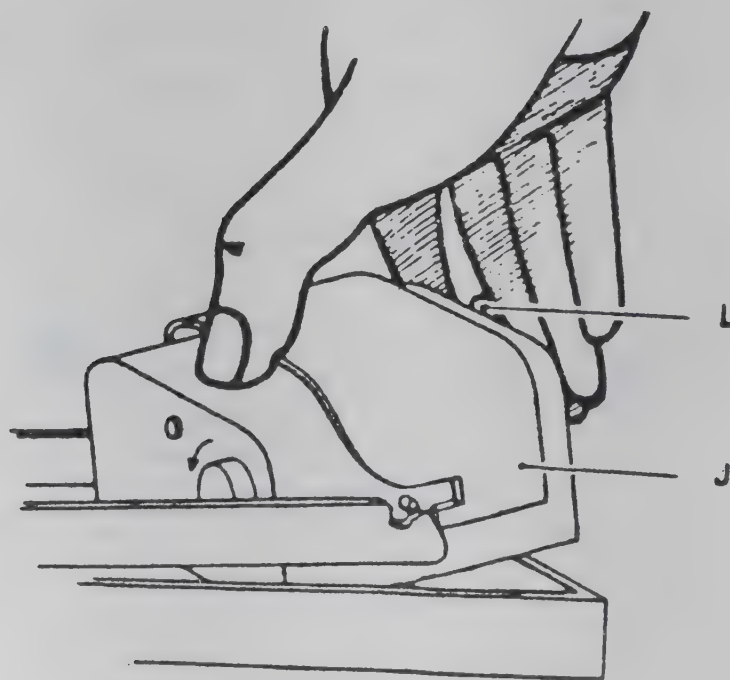


FIG. 3

- (3) Jerk out magazine by pulling plate "J" from the rest of the magazine (see above)

CAUTION Do not press knob 'L' while holding the magazine.

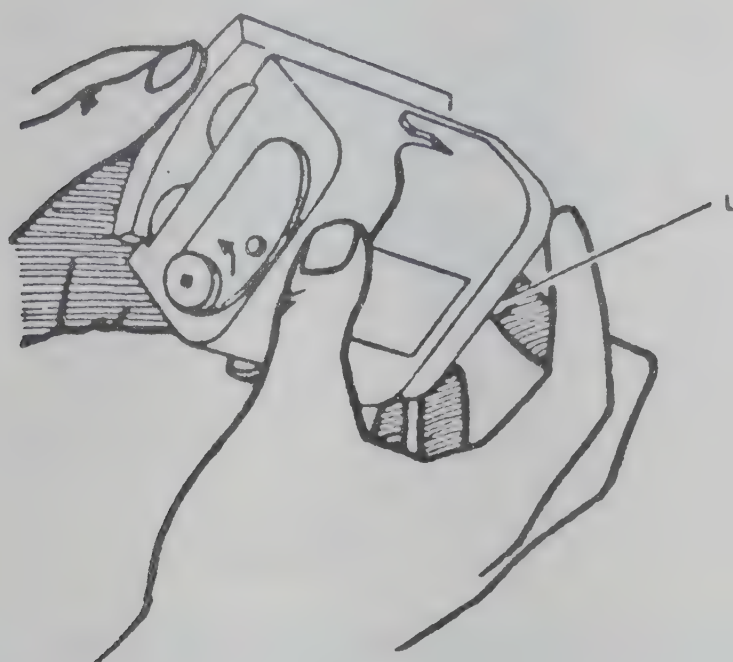


FIG. 4

- (4) Detach the pressure plate assembly by pressing the knob 'L'. (See above) and keep the magazine cover down.
- (5) Remove the empty spool from right side spindle and transfer it to the left side spindle (if magazine does not have an empty spool put one on the left spindle; if left hand spindle holds exposed film spool, this spool is taken and kept aside).

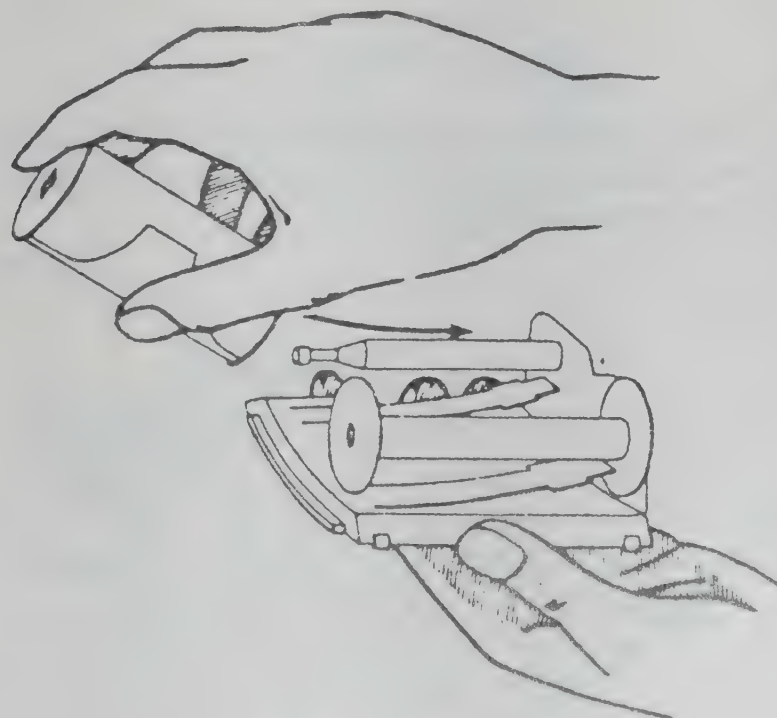


FIG. 5

- (6) Open the fresh film container. Remove the spool and put it in the remaining spindle (right side) of the magazine pressure plate assembly (see above). If exposed film was removed from the magazine earlier (5 above) put the exposed film in the container of the fresh film and close it.

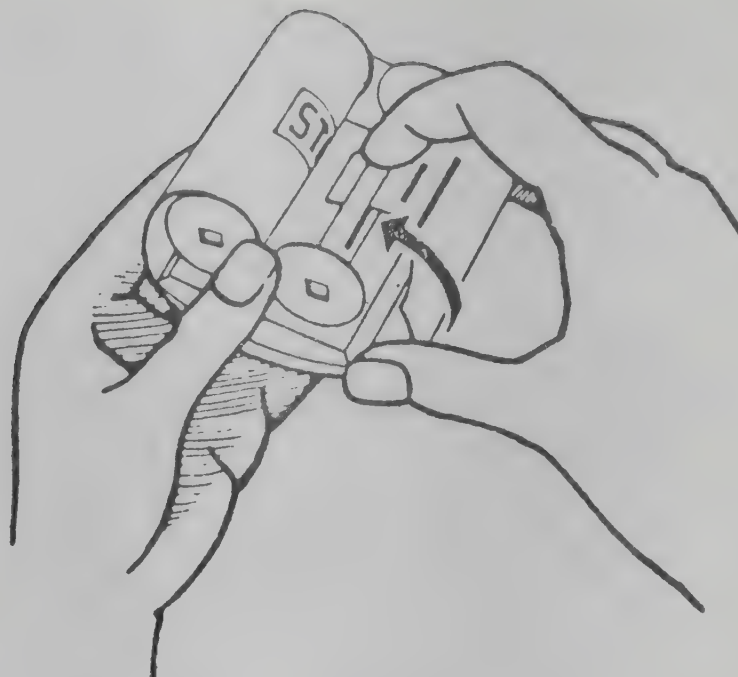


FIG. 6

Remove the sticking tape from the fresh film which is now on the magazine spindle. Roll out a length and pass it over the pressure plate and insert the free end of the film on the empty spool (see above). If a partially used (cut length) film is used, before inserting the film, cut the film end to give it a tapered end using scissors.

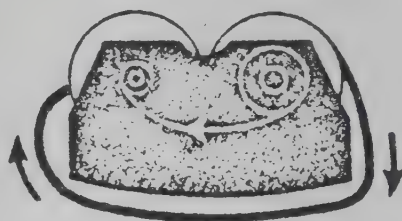


FIG. 7

Turn the empty spool 2 or 3 turns using its flange to hold the film properly while the film on the full spool is held on to prevent slackness of the film on the pressure plate (see above). Check the even seating of the film on the pressure plate.

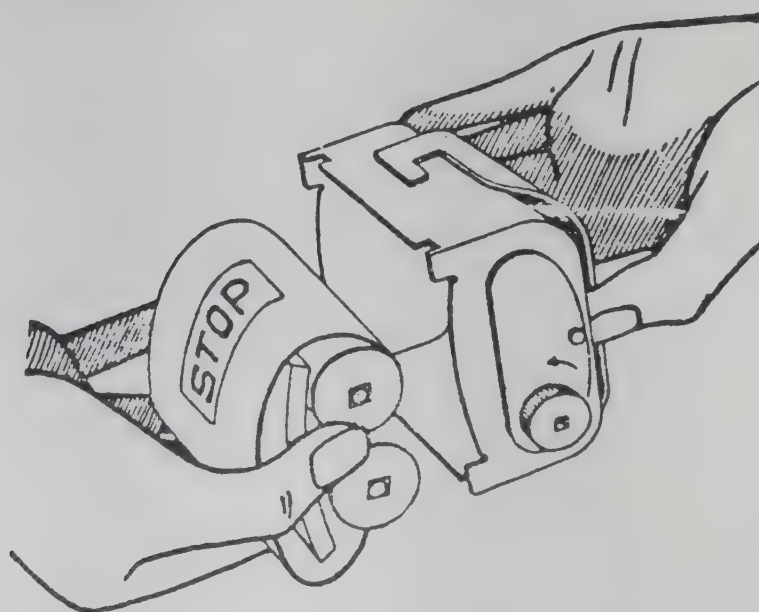


FIG. 8

Insert the pressure plate to the magazine cover while knob 'L' is pressed (see above).

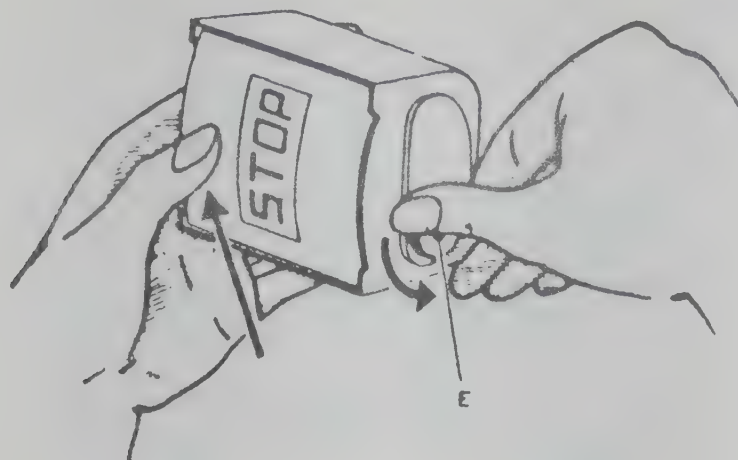


FIG. 9

- (7) Wind the clutch "E" till the clutch plate engages into the square hole of the film spool. Turn the clutch further to tighten the film around the pressure plate and to check that film is properly held by "take up spool" i.e., empty spool. (see above). Re-check the even seating of the film on the pressure plate.

If a new roll of film is used it will be possible to feel a round hole punched into centre of the width of the film or printed word "stop".

The film clutch should be wound till film mark mentioned above is in centre of the pressure plate.

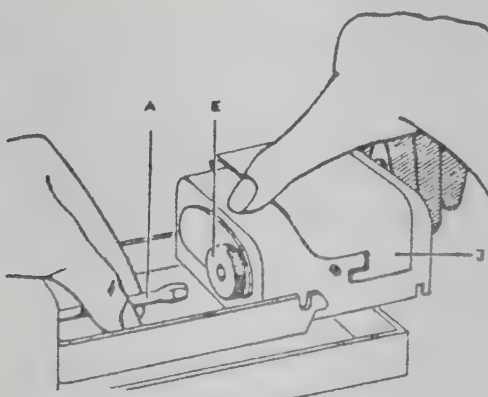


FIG. 10

- (8) Holding winding spindle with free hand insert the magazine between the bars of the yoke 'G' while plate 'J' of the magazine is pressed back. Release plate 'J' and allow the hook 'B' to engage into the ends of the yoke. If necessary, turn the clutch 'E' to fully engage the hexagonal end of the winding spindle to hexagonal hole of the clutch 'E' (see above).

For RFC-2 Cassettes (only) see Fig. 11.

Check the seating of the film as shown with your finger.

- (9) Turn the winding knob 'K' to the fully wound position and slowly allow it to come back to the normal position by the action of the spring.

NOTE: If the cassette is R.F.C. 2 pull back the dark slide and feel the film to make sure that it is placed evenly without buckle and edges are not torn. If film is torn or

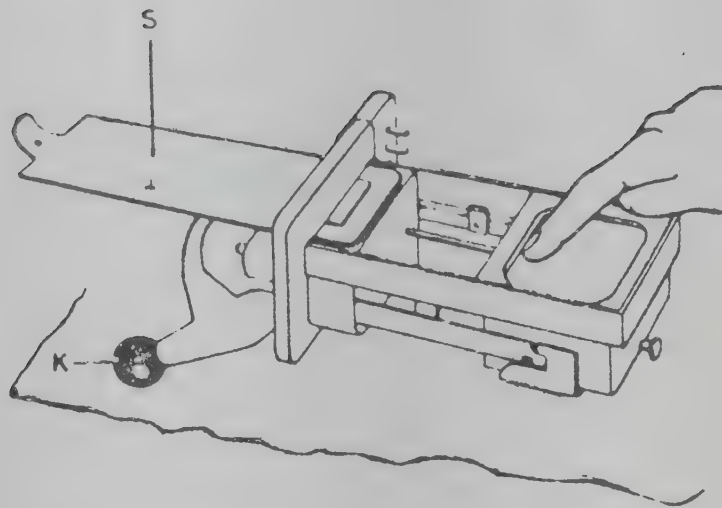


FIG. 11

buckled remove the magazine (Fig.3) above) re-check the film loading in the magazine and proceed step by step to 11.

(10) Press catch 'T' to reset the numbering and film compensation device.

NOTE: Exposed frames overlapping is often due to forgetting to reset the film compensation device inside the cassette. Sometimes numbering system may not work due to catch spring breaking inside the housing. Even then film compensation device can work properly to give even spacing between exposed frames without overlapping.

(11) Wind the knob 'K' 2 or 3 more times to check that the film transport is free. Before taking the loaded cassette to the camera from the dark room put it in a bag made of thick black cloth to avoid fogging of the film due to light leakage.

(B) SINGLE FILM CASSETTE SFC.3U/SFC.4

Parts of the cassette are shown in Fig 11(a) and Fig.11 (b).

Parts of single film cassette : F – Steel frame, S – Dark slide, C – Cam, V – Spring catch (on camera), H – Grip, A – Cover plate, D – Pressure plate with P – Locking plate, K – Knob, M – Milled Nut N – Notch.

SFC.4 cassette has a glass plate like RFC-3 cassette in its film gate and should be cared for as mentioned under RFC-3.

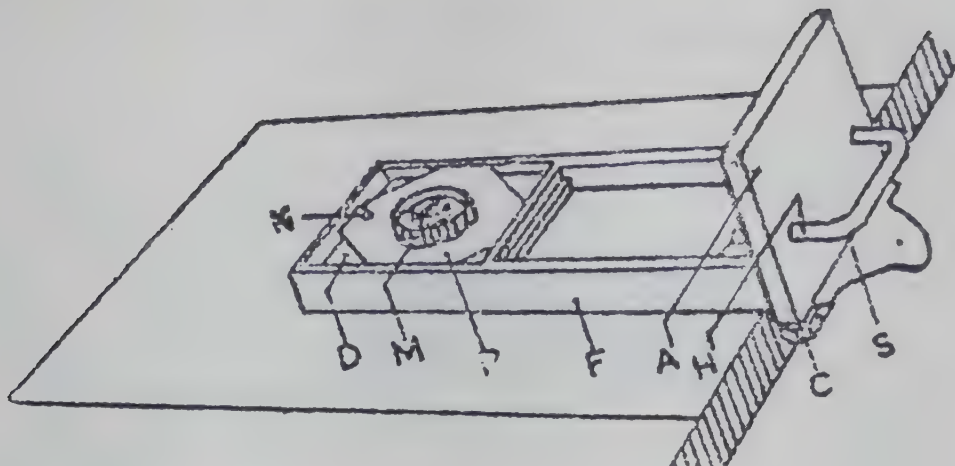


Fig.11(a)

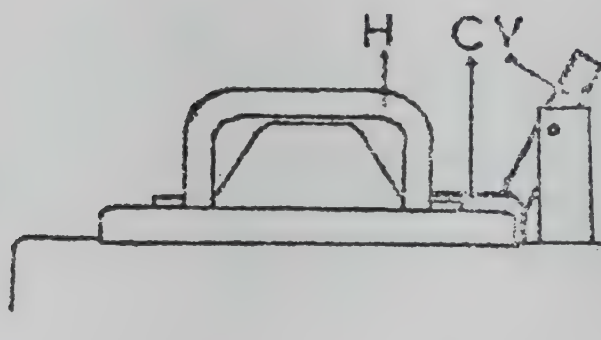


Fig.11(b)

Loading of the cassette is as follows:

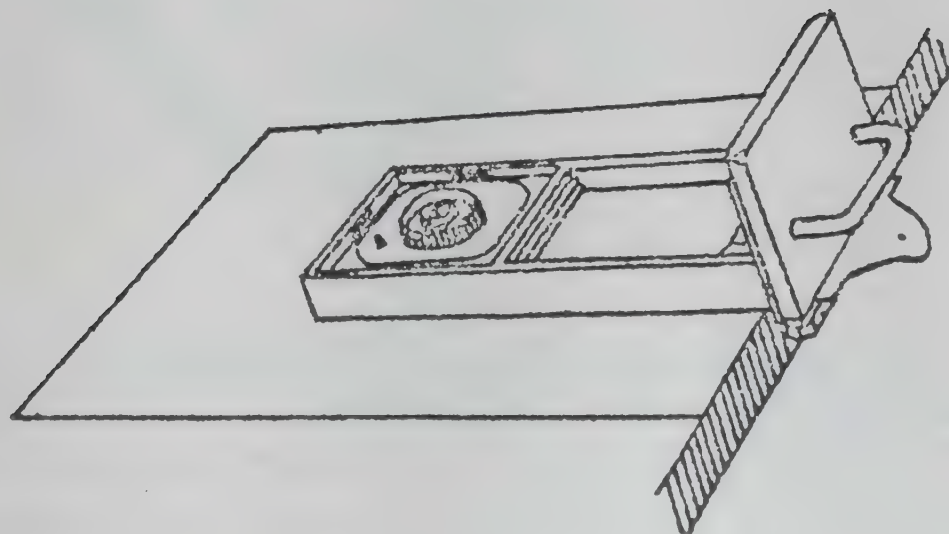


FIG. 12

- (1) Place the cassette on a smooth dust and grit free surface of a table so that cover plate 'A' rests outside the edge of the table (see above). Keep a box of unexposed films and a box

for exposed films in a convenient place at the table so that they can be located and identified easily in the dark. Switch off the light.

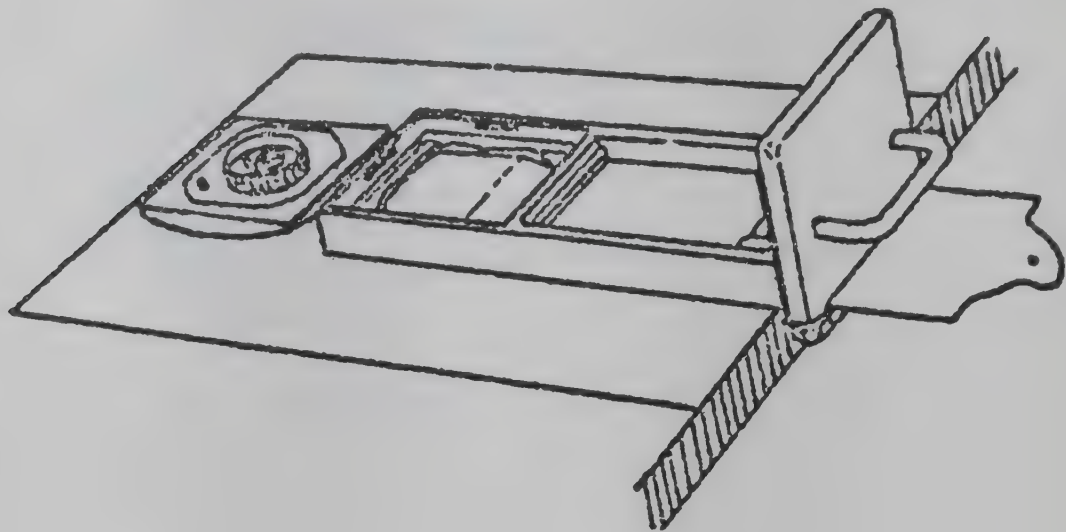


FIG. 13

- (2) Slacken the milled nut 'M' by turning it $\frac{1}{2}$ turn anticlockwise and turn lock plate 'P' with the knob 'K' $\frac{1}{8}$ th turn in anticlockwise direction and lift the pressure plate 'D' out of the cassette and rest it on the table (see above).

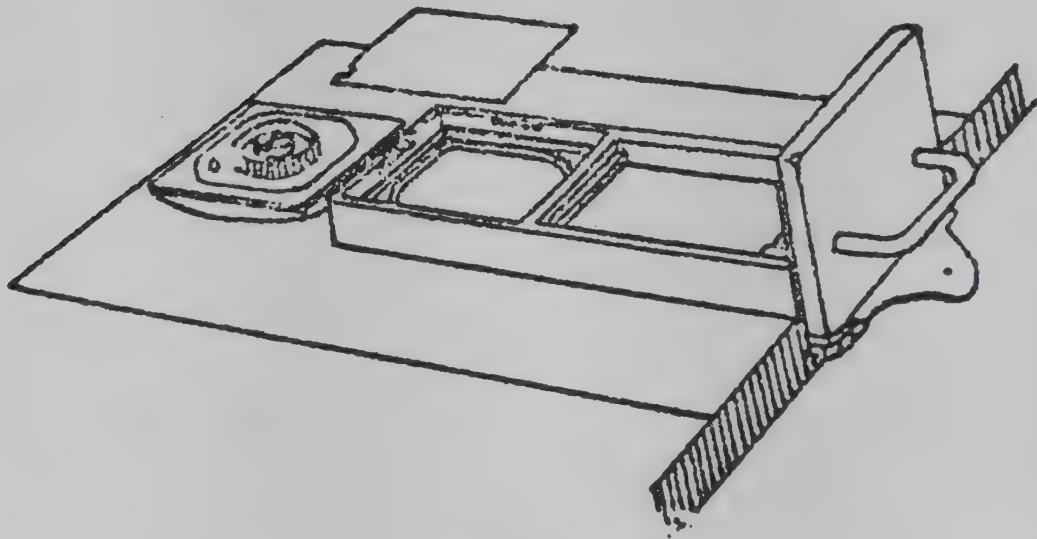


FIG. 14

- (3) Remove the exposed film if cassette was used earlier from the film gate and put it in the box for exposed film and close its cover. Open the box containing unexposed films. Take out one film and hold it so that the notch of the film is in top left hand corner (see above).
- (4) Insert the film in the cassette. Replace the pressure plate. Turn the locking plate $\frac{1}{8}$ th turn clockwise and tighten the milled nut 'M' clockwise $\frac{1}{2}$ turn. Replace the lid of the fresh film box.

Cassette is ready to be inserted into the camera. Fix it to camera as mentioned under RFC. Intermediate piece is not needed for SFC cassette.

I-TRANSFERRING THE EXPOSED FILM FOR PROCESSING

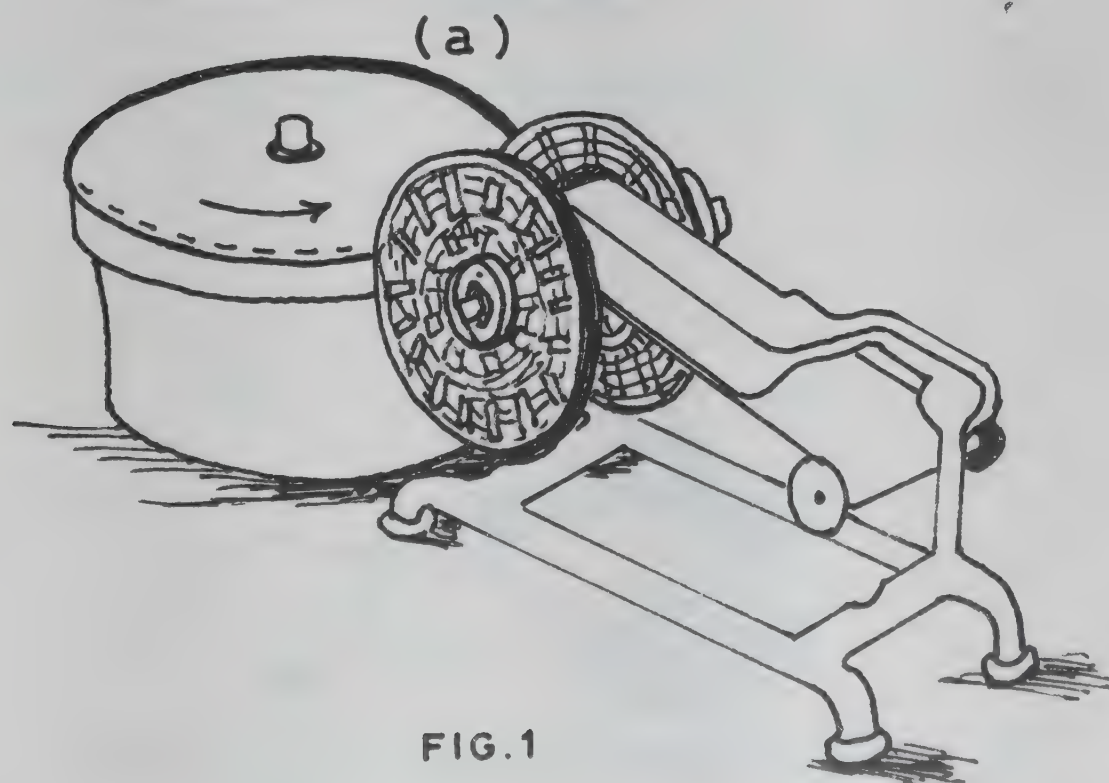
(A) Roll Film

Film processing is to be done in total darkness.

Following items are required:

- (1) Plastic spiral spool P.T.W - one
- (2) Film spooling device RSD - one
- (3) 2 litre developing tanks with lid and spinning rod 3 Nos. one each for developer, fixer and rinsing water
- (4) Thermometer
- (5) Dark Room Timer
- (6) Stainless steel vessel with ice (when temperature of the solution is higher than 20°C)
- (7) One long rubber tube suitable for fixing to water tap on one end and glass tube on the other (see Fig 7 page 17).
- (8) Two plastic buckets one containing water and other containing a very dilute solution of wetting agent (lidet, Teepol etc)
- (9) Towel to keep hands dry before handling the film.

FILM SPOOLING WITH SPOOLING DEVICE



Fix the spiral spool to the spooling fixture by passing the triangular end in first on to the rotating spindle of the spooling fixture. Move the film lock free.

Switch off the lights and insert the exposed film spool on the fixed spindle of the spooling device such that the square holed flange is inserted first. Pull out a length of the film through the film guide and trim if necessary the end with scissors to give it a tapered edge.

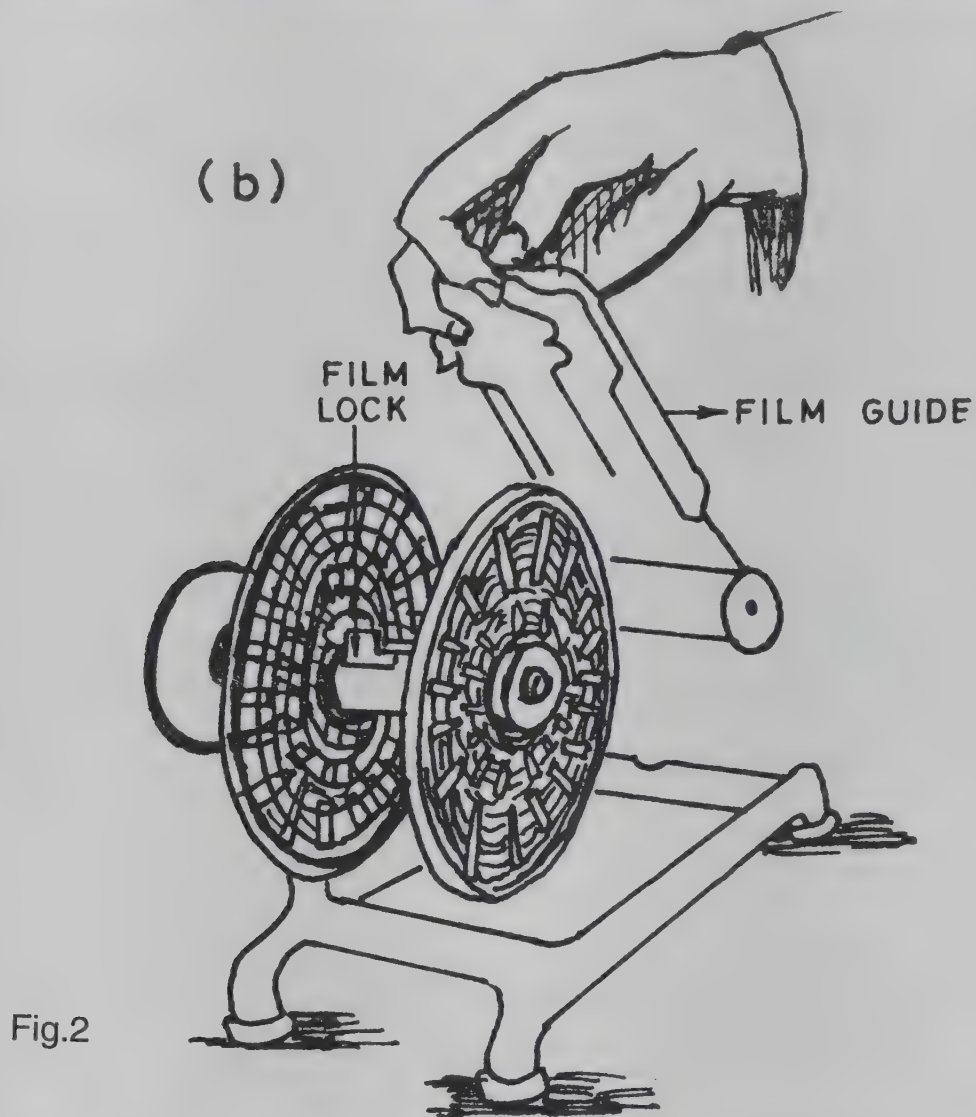


Fig.2

Rest the film guide on the spindle of the spiral spool and insert the free end of the film into the slot of the spindle and push the film lock to lock the film.

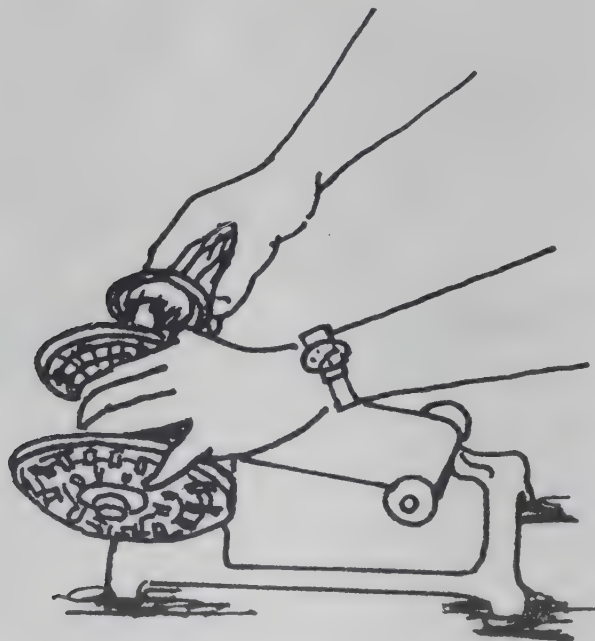


FIG. 3

Hold the film guide lightly with one hand so that ring finger, and index finger are lightly touching the film and slowly wind the R.S.D. handle. If buckling of film is felt reverse the winding slightly to remove the film buckling and wind on till the full film is wound on the spiral spool. Lift the film guide away and trace the last end of the film. Pull it out slightly and cut off the curled end of the film to prevent it touching the wound film in the spiral spool.

Hold the spool by the round nut of spiral spool and pull it out of the R.S.D. Move to wet bench and insert the film in developer. Cover it with lid and develop the film (Refer 4.6.1 for details).

(B) Single Film

Keep the single film rack with grip and the box containing exposed films on the dry bench and dry the hands well. Switch off the light. Open the box and remove the film.

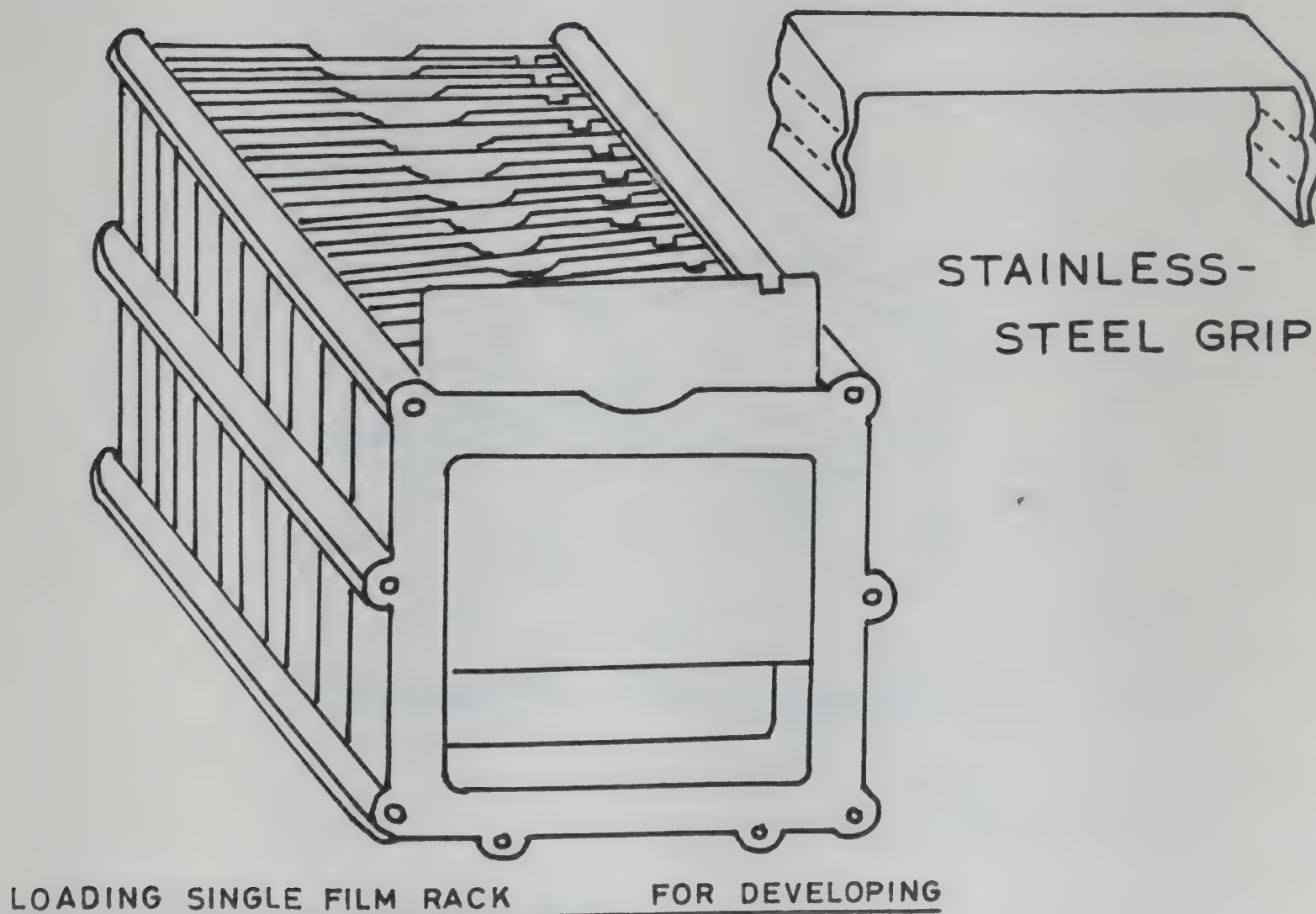


FIG. 4

Insert the film one after the other in the rack, as shown in Fig.4. When all the films (not more than 12 at a time) are inserted in the rack, fix the grip. Put the rack in the developer and agitate.

Complete the development rinsing and fixing as mentioned earlier for roll film. Wash the film.

II - FILM WASHING

- Step 1 — Keep two buckets of water as shown in Fig.5.
- Step 2 — Keep a piece of wet absorbent cotton (Approx.80 mm wide) as shown in Fig.6.
- Step 3 — Pull out the end of the film from the spool and pass it over the cotton covering it with a similar piece of cotton. Let the free end of the film fall into the bucket containing wetting solution (Fig.7).
- Step 4 — Pull out the film from the spool while it is pressed between the absorbent cotton pieces and allow it to fall into the bucket containing the wetting solution till all the film from the spool is transferred to the wetting solution.
- Step 5 — Take the RDF hanger. Clip one end of the film from the wetting solution and wind the film completely on the RDF and keep it for drying in drier if available.

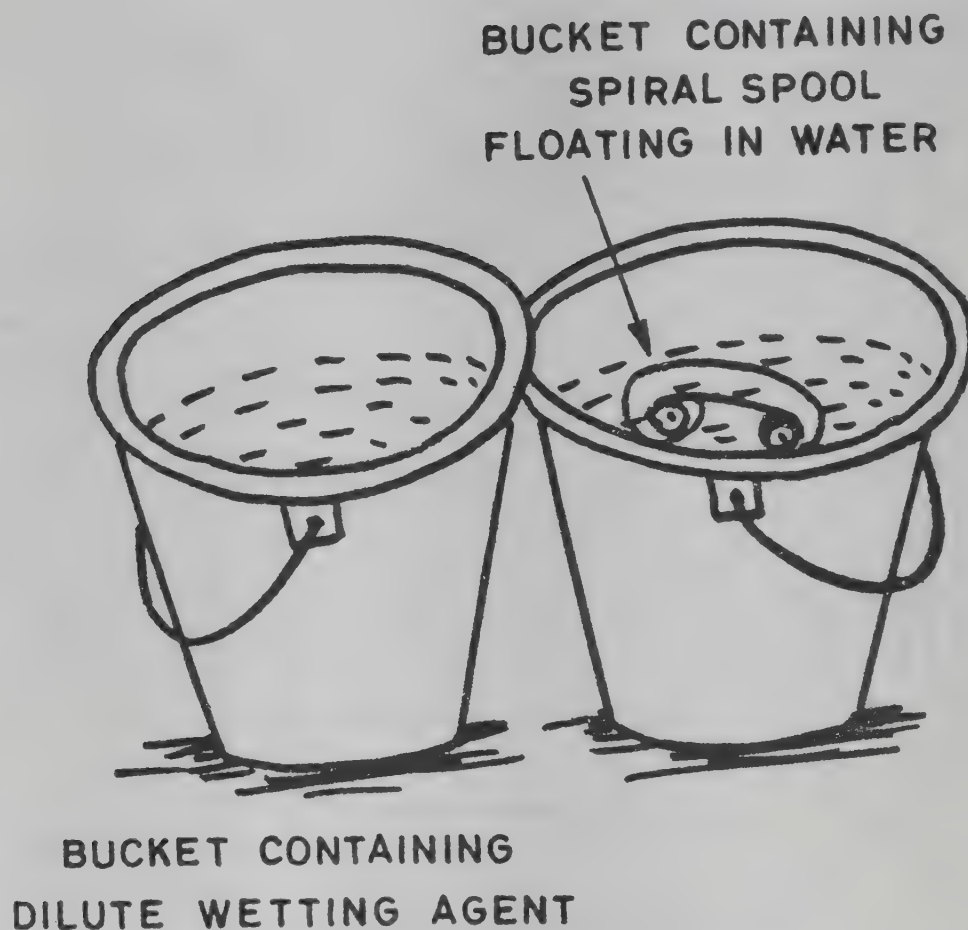
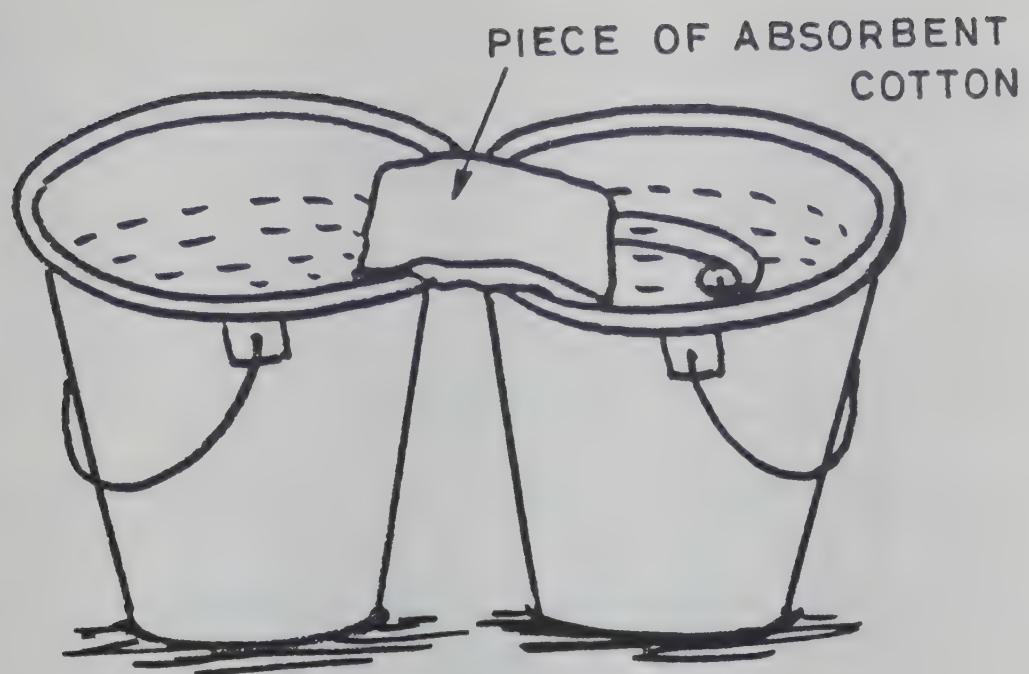
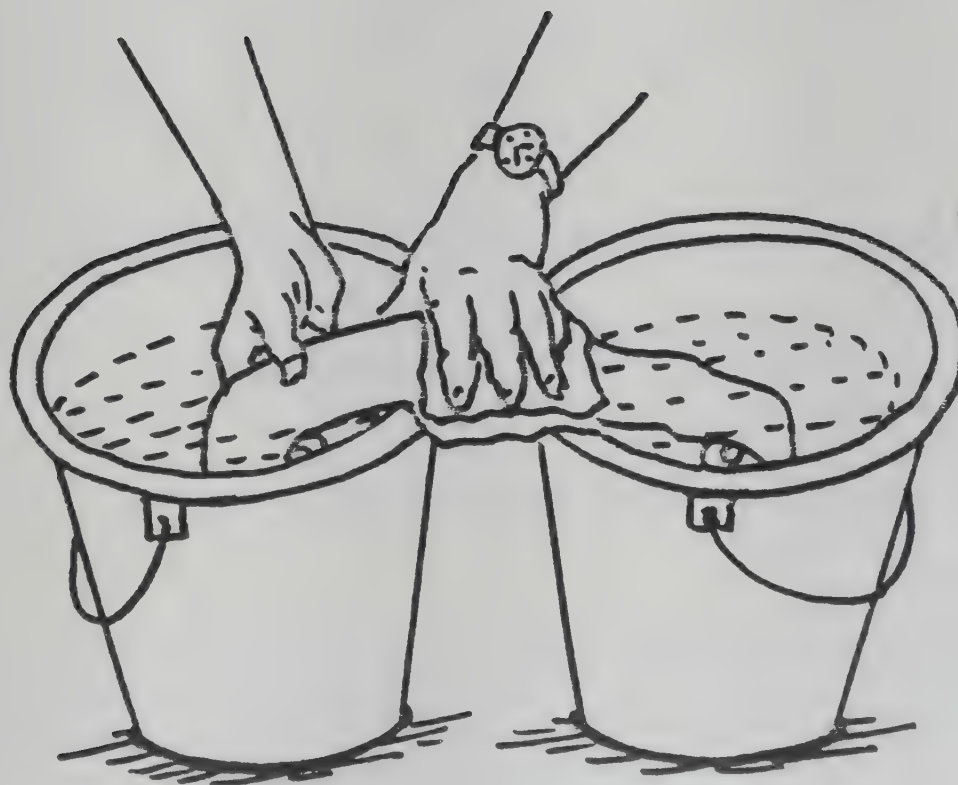


FIG-5



FIG·6



PULLING THE FILM FROM THE
SPOOL

FIG·7

LINE TESTER

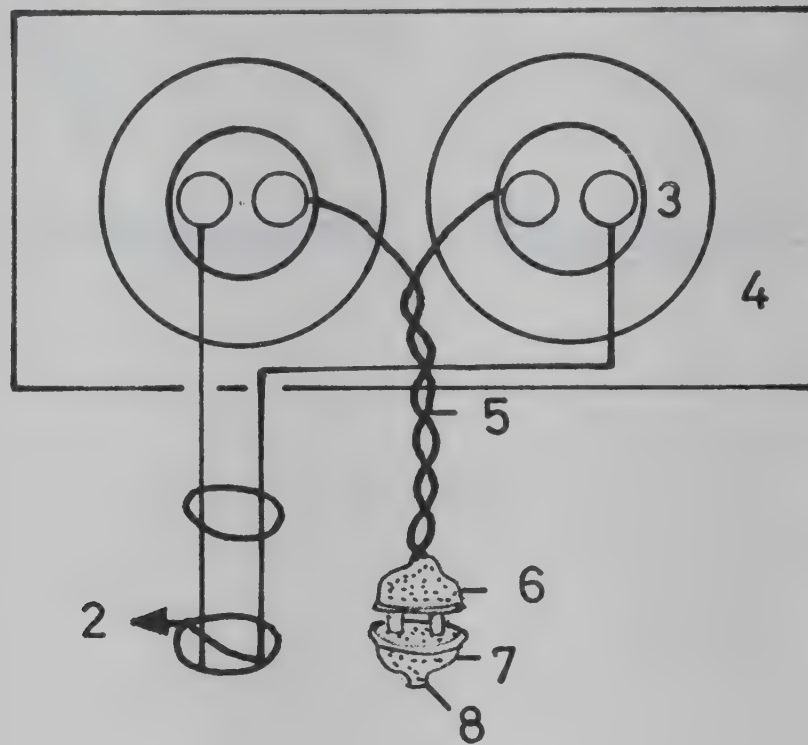
Components of the line tester

FIG. 1

- (1&2) Single core 3/22 wire 3 metres long cut into equal pieces and bared of insulation at one end (2)
- (3) 2 lamp holders for bayonet cap type bulbs
- (4) One teak wood board 20 cm × 10 cm for fixing lamp holder
- (5) 3 metre flexible twin core wire
- (6) 1 two pin plug
- (7&8) 1 female adaptor plug with interconnecting link (8).

Assembling of line tester

The single core wire is cut into 2 pieces of equal length. Connect one wire to each of the lamp holders as shown in figure above. Connect the remaining 2 terminals of the lamp holder to the twin core flexible wire. Connect the male plug to the remaining end of the flexible wire. Open the female adaptor plug and connect the two female sockets together by a bare wire (8) and close the female adaptor plug. Bare the insulation of the 2 single core wire ends which are left out to a length of 1 cm each (2).

Testing of line tester:

Fix two Nos.15 watts 230 volts bulbs in the lamp holder. Plug male adaptor plug to a 2 pin power supply carefully holding the single core cables away from the bare ends and switch on the

power supply. Transfer one of the wires to the free hand and touch the bare end of the wire held o. the left hand (not with hands) with that on right hand. The two lamps should now be glowing. Switch off the power supply and remove the adaptor plug from the power supply. Connect the female plug to the adaptor. Insert the bare ends of the single core wire to power supply plug. Both lamps should glow.

Use of line tester:

For testing continuity of wires, fuses, pilot lamp bulbs etc., plug the male plug of the flexible wire (after removing the female socket) to a 230 volts power supply (wall plug).

CAUTION Do not touch the bare end of the single core wire or allow it to touch any part of your body

Carefully take hold of the single core wires one in each hand avoiding the bare portion of the wire and touch either end of the items i.e. fuses, cables, etc., as required. If the lamps on the line tester are lighting, the part concerned is having continuity. In case of Neon lamps though the line tester lamps will not glow the Neon lamp will glow if they are good.

Testing the power supply:

Connect the female plug to the flexible cable male plug holding the 2 single core cables (avoiding the bare ends of the wire) touch the supply points which are to be tested. If the power supply is 230 volts the bulb will glow dimly, and if 400 volts it will glow brightly.

